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THESIS

ENERGY CRISIS IN PAKISTAN

by

Malik Naseem Abbas

December 2015

Thesis Advisor:	Robert E. Looney
Co-Advisor:	Siamak T. Naficy

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It is a universal phenomenon that the socio-economic progress of a state is significantly dependent upon the performance of the energy sector, as the energy sector drives the engine of growth and development in agricultural, industrial, and defense sectors, in addition to impacting domestic users. In Pakistan, the increasing gap between the demand for, and the supply of, energy has brought economic progress to a standstill. A number of industries have been closed due to this increasing gap, which is expected to grow even further.

Despite huge indigenous potential and its geographical significance as a potential energy corridor between the Middle East and Central Asia, Pakistan's energy sector fails to secure its energy needs. The goal of this thesis is to evaluate why Pakistan's energy crisis is worsening day by day, and how the country can best secure its energy needs.

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ENERGY CRISIS IN PAKISTAN

Malik Naseem Abbas
Lieutenant Colonel, Pakistan Army
BSc, Baluchistan University, 2007

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Approved by: Robert E. Looney
Thesis Advisor

Siamak T. Naficy
Co-Advisor

Mohammed Hafez
Chair, Department of National Security Affairs

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LIST OF ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
AEDB	Alternative Energy Development Board
AREs	Alternative Renewable Energies
Bcma	Billion Cubic Meters Annum
CNPC	China National Petroleum Company
CO2	Carbon Dioxide
CPEC	China–Pakistan Economic Corridor
DISCOs	Distribution Companies
FATA	Federally Administered Tribal Areas
FESCO	Faisalabad Electric Supply Company
GDP	Gross Domestic Product
GENCOs	Generation Companies
GEPCO	Gujranwala Electric Supply Company
GSP	Geological Survey of Pakistan
GUSA	Gulf-South Asia
HEB	Hydro Electric Board
HESCO	Hyderabad Electric Supply Company
IEA	International Energy Agency
IESCO	Islamabad Electric Supply Company
IPEO	International Panel of Experts
IPI	Iran Pakistan India
IPPs	Independent Power Producers
KESC	Karachi Electric Supply Company
KPK	Khyber Pakhtunkhaw
KSA	Kingdom of Saudi Arabia
LESCO	Lahore Electric Supply Company
LNG	Liquefied Natural Gas

MBTU	Million British Thermal Unit
mcm	Million Cubic Meter
ME	Middle East
MEPCO	Multan Electric Supply Company
Mmst	Million Short Tons
MoU	Memorandum of Understanding
MPNR	Ministry of Petroleum and Natural Resources
MTOE	Million Ton of Oil Equivalent
MW	Megawatt
NEPRA	National Electric and Power Regulatory Authority
NREL	National Renewable Energy Laboratory
NTDC	National Transmission and Dispatch Company
OECD	Organization for Economic Cooperation Development
OGDC	Oil and Gas Development Company
OGRA	Oil and Gas Regulatory Authority
PARCO	Pak-Arab Refinery Complex
PESCO	Peshawar Electric Supply Company
PIP	Pakistan Institute of Petroleum
PMLN	Pakistan Muslim League Nawaz
PPIB	Private Power and Infrastructure Board
PPL	Pakistan Petroleum Limited
PV	Photovoltaic
PwC	PricewaterhouseCoopers
QESCO	Quetta Electric Supply Company
R&D	Research & Development
RE	Renewable Energy
RPPs	Rental Power Projects
SBP	State Bank of Pakistan
SHYDO	Sarhad Hydel Development Organization

SPR	Strategic Petroleum Reserves
TAPI	Turkmenistan Afghanistan Pakistan India
Tcf	Trillion Cubic Feet
T&D	Transmission & Distribution
TESCO	Tribal Electric Supply Company
UNCOL	Union Oil Company of California
UNDP	United Nations Development Program
USAID	United States Assistance for International Development
USGC	United States Geological Survey
WEO	World Energy Outlook

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I offer my deepest tribute to the shining galaxy of unparalleled professors, my colleagues, and friends. I had the good fortune and honor of knowing them intimately during my affiliation with this great institution. However, I will not enlist all for fear of inadvertently missing anyone, yet I cannot do away without expressing my wholehearted gratitude for my thesis advisor, Professor Robert E. Looney; co-advisor, Professor Siamak T. Naficy; and writing coach Dr. Cheryl Huddleston for their guidance, support, and patience.

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I dedicate my thesis to my late father, who never got a chance to go to any school, but left no stone unturned to help us glide through the trajectory of education. My loving father, you will always be remembered. May your soul rest in eternal peace.

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I. INTRODUCTION

A. MAJOR RESEARCH QUESTION

This thesis explores the question, why has Pakistan not been able to achieve energy security? It is a universal phenomenon that the socio-economic progress of a state is significantly dependent upon the performance of the energy sector, as the energy sector drives the engine of growth and development in agricultural, industrial, and defense sectors, in addition to impacting domestic users. In Pakistan, the increasing gap between the demand for and the supply of energy has brought economic progress to a standstill. A number of industries have been closed due to this increasing gap, which is expected to grow even further in the future. Despite huge indigenous potential and its geographical significance as a potential energy corridor between the Middle East and Central Asia, Pakistan's energy sector fails to secure its energy needs. The goal of this thesis is to evaluate why Pakistan's energy crisis is worsening day by day and how the country can best secure its energy needs.

B. IMPORTANCE

This study bears undeniable implications on the country's growing economy. In Pakistan, the energy crisis is the single largest drain on the economy, which cuts gross domestic product progress by more than 2 percent each year.[1] This crisis stems from the policy of fuel mix transformation introduced almost 20–25 years ago, when imported furnace oil became the primary source of power generation, rather than a greater diversification of energy. With over a 9 percent annual increase in energy demand, total demand has increased four times in the last two decades. This amount is likely to double in the next decade and a half, that is, by 2030.[2]

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[1] Elizabeth Mills, "Pakistan's Energy Crisis," *Journal of Peace Works, United States Institute of Peace* 79, no. 4 (June 2012): 7. Mills is a freelance consultant with a focus on energy, environmental, and geopolitical issues. She has written about South Asia for more than a decade and has lived and worked in the region.

[2] Shoukat Hameed Khan, "Pakistan's Energy Vision 2030," in *Solutions for Energy Crisis in Pakistan*, ed. Mushir Anwar (Islamabad, Pakistan: Islamabad Policy Research Institute, 2013), 217.

Various studies on the impact of energy security conducted by the International Energy Agency (IEA) and other energy-related international institutions indicate that energy availability has an undeniable bearing on the economic progress and stability, quality of life, good governance, and outcome of the overall security environment.[3] As a result, global demand for energy is "expected to double by 2050 as compared with 2000 levels, and 90 percent of growth in energy demand will be driven by emerging economies as more people move out of poverty, demanding more energy and gaining access to it."[4] Therefore, securing energy needs from existing fossil fuels, while discovering new and sustainable forms of energy to meet growing energy needs, is the new "great game" of the day.

C. LITERATURE REVIEW

The primary objective of this thesis is to determine why Pakistan has been unable to address ever-increasing energy shortfalls. In my preliminary research, I have examined a wide range of peer-reviewed literature, academic journals, government-sponsored studies, and literature on energy seminars. These touch upon different aspects of the topic, but what I perceive is lacking in scholarship is an approach to analyze Pakistan's energy basket as a whole, along with political, regional, and global implications. Current literature reveals that energy poverty is a diverse, long-standing, and multifaceted issue. However, economists regard it as an issue of only circular debts.[5] Elizabeth Mills, an expert on energy and environmental issues, has described Pakistan's energy problems as follows: "For the political observers, it is an issue of absent political will. For the aid

[3] Vladislav Vucetic and Achilles G. Adamantiades, "Power Sector Reforms in Pakistan: Issues and Challenges," in *Fueling the Future: Meeting Pakistan's Energy Needs in the 21st Century*, ed. Robert M. Hathaway, Bhumika Muchhala, and Michael Kugelman (Washington, DC: Woodrow Wilson Center Press, March 2007), 113.

[4] Hamid Hasan Mirza, "An Overview of Pakistan's Energy Sector: Policy Perspective," in *Solutions for Energy Crisis in Pakistan*, ed. Mushir Anwar (Islamabad, Pakistan: Islamabad Policy Research Institute, 2013), 13.

[5] *Circular debt* refers to a structural problem in Pakistan's energy market. It arises when one party, in this case, the government, withholds payments. This affects others in the supply chain, notably the power-generating companies, with each in turn withholding payments. This results in operational problems for the sector's service providers, ensuring that power availability drops. According to the 2010 Pakistan Energy Yearbook, five of twenty-two of the country's independent power producers failed to produce electricity in 2009, and the rest operated at a capacity of just 60 percent. It is likely that circular debt issues were at least partly responsible for this situation.

organization specialist, it is a governance problem. For the engineer, it is a matter of resolving technical problems, improving energy conservation, and addressing issues like theft and nonpayment of electricity bills."[6] The aforementioned problems are logical, yet regional energy and geopolitics are important additional factors that seriously impact Pakistan's current energy scenario. This situation is a testimony to the country's inability to capitalize on regional energy resources. Therefore, the review of literature can be summarized as follows.

1. Current Energy Situation

Pakistan is entangled in a severe and lingering energy crisis, which besides impacting life for the average citizen is also affecting the economic cycle of the state. Despite having installed energy capacity beyond peak time requirements, exceptionally high tariffs make energy unaffordable for domestic users and uneconomical for commercial purposes.[7] There are also a number of factors which make the system inept to deliver the goods and, as a result, energy produced is not sufficient to meet the demand. In a few decades, Pakistan's energy demand has increased about 80 percent, with unsustainable supply catching up to the demand.[8] As a result, in electricity alone, Pakistan is experiencing a gap of almost 5,000–6,000 megawatts (MW), which is almost 33–35 percent of the total requirement.[9] It is important to note that considerable numbers of the population either do not have access to grid electricity or use non-commercial sources of electricity.

Unfortunately domestic energy supplies are gradually diminishing.[10] In particular, the available oil and gas resources are forecast to be exhausted between 2025 and 2030,

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6 Mills, "Pakistan's Energy Crisis," 23.

7 Mushir Anwar, ed., *Solutions for Energy Crisis in Pakistan* (Islamabad, Pakistan: Islamabad Policy Research Institute, 2013), 87.

8 Khan et al., "Measures for Reducing Transmission and Distribution Losses of Pakistan," *International Journal of Scientific and Engineering Research* 4, no. 4 (April 2013): 617.

9 Ahmad Fraz Khan, "Power Shortfall Increases to Over 5,000MW," *Dawn*, April 22, 2011.

10 The domestic energy sources consist of natural gas, hydel power, about one-third of our crude oil supply, and small quantities of coal and nuclear energy.

respectively.[11] Analysts suggest that because of Pakistan's inability to develop indigenous energy sources, its import bill may shoot up to and even beyond 75 percent by the mid-2020s.[12] Subsidizing fuel costs, partially to ease the financial burden on the population but mainly to survive against public frustration, has further stressed the state's already crippled economy. According to a recent statement by Pakistan's federal finance minister, the state has to release approximately one trillion rupees annually to make up for the subsidies and losses of state-owned power companies.[13]

The State Bank of Pakistan (SBP) has already cautioned the federal government of dire economic consequences if tangible measures to secure energy needs are not taken on priority basis.[14] The textile industry, the mainstay of Pakistan's gross domestic product (GDP) with the biggest chunk in exports, has stumbled due to the power crisis. Tariffs on available marginal energy have resulted in high manufacturing costs. Lack of required energy has affected the services equally. The rail industry, considered to be the most efficient means of transportation, has limited its operations on most routes, reduced the number of routes, and even contemplated a complete shutdown of operations due to fuel shortages. As for employment, according to one estimate, "4.1 million jobs and employment opportunities have been lost since 2008 due to the country's energy problems—roughly 7.5 percent of the workforce."[15]

2. Political and Policy Issues

Review of available literature reveals that there is a significant acknowledgment of the severity of the energy crisis. Numerous high-level committees of think tanks have been constituted to formulate an all-inclusive and cohesive energy policy for the country, but there has always been an absolute failure to galvanize the effort and translate policy

11 Mills, "Pakistan's Energy Crisis," 27.

12 Zeeshan Javaid, "Energy Crisis Affecting Social, Economic Uplift," *Daily Times*, September 7, 2011.

13 Sohail Iqbal Bhatti, "Finance Ministry cut Subsidy to power consumers by Rs60 bn," *Dawn*, August 12, 2014.

14 Javed Mirza, "Energy Crisis to Weigh Heavy on Economic Growth Prospects," *The News*, January 1, 2012.

15 "Ex-Minister to Defense RPP Contracts in SC," *Dawn*, October 29, 2011.

into action. The energy sector has long been affected by ad-hoc decision-making by the government. The absence of single-energy regulatory authority further compounds the issue:

> Important issues such as the close linkage between various forms of energy, the affordability and sustainability of energy supplies, the linkage between choice of technologies and resultant cost of energy etcetera never received the attention of our policy makers and planners in the absence of a comprehensive policy. Piece-meal policies, … formulated to meet urgent short-term needs, were neither adequate nor effective for ensuring energy security for the country.[16]

Some challenges require political will and developing consensus, while others necessitate substantial financing and institutional corrective measures.

Many studies suggest a time frame Pakistan could take to tackle the energy issue. Chapter 9 of *Planning Commission of Pakistan, Vision 3030* also speaks volumes about energy security. In 2007 an energy framework was formulated, in consultation with hundreds of experts, by the Planning Commission of Pakistan under then-Prime Minister Shoukat Aziz. Today, plans and progress are far apart: The situation on the ground is much worse. Similarly, during 2013 elections, electricity was the major agenda of the Pakistan Muslim League (PML), the sitting ruling party. PML made numerous contradicting promises with different timelines to address this issue, but unfortunately, it remained more of a political stunt than a resolve.[17] For example, "the Asian Development Bank (ADB) report, published in 2010, argued that with swift action Pakistan could be on the right energy trajectory within three years."[18] On the other hand, while inaugurating a 404 MW Uch-II power plant at Dera Murad Jamali (Baluchistan Province) on April 25, 2014, Prime Minister Nawaz Sharif claimed that the energy crisis would be overcome in three years.[19] A year later, on March 22, 2015, the prime minister said in a public address

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16 Hamid Hasan Mirza, "An Overview of Pakistan's Energy Sector," 7.

17 It was hoped that Pakistan Muslim League-Nawaz (PML-N) would place a greater priority on addressing the country's energy problems than the current government. This is due to the party's pro-business focus and moves it has made in Punjab to alleviate power shortages.

18 Asian Development Bank, *Pakistan: Energy Sector Restructuring Program*, February 2014, http://www.adb.org/documents/pakistan-energy-sector-restructuring-program-0.

19 "Energy crisis will be overcome in three years," *Geo News*, April 25, 2014, accessed November 16 2015, http://www.geo.tv/article-145712-Energy-crisis-will-be-overcome-in-three-years-PM-Nawaz-.

that "most of his government's time is consumed in tackling terrorism and the acute energy crisis which leaves little time for development works."[20] The government's claims have always lacked any viable implementation strategy.

From the review of literature, it can be concluded that Pakistan urgently requires an all-encompassing, futuristic, and implementable energy policy. Policies framed over a period of time mostly focus on short-term solutions and fall prey to bureaucratic, rather than national, interests. Unfortunately, a desirable, comprehensive energy plan is still not on the horizon. Ioannis N. Kessides writes, "Pakistan's energy bankruptcy is ultimately due to massive institutional and governance failure."[21]

3. Regional and Global Aspects

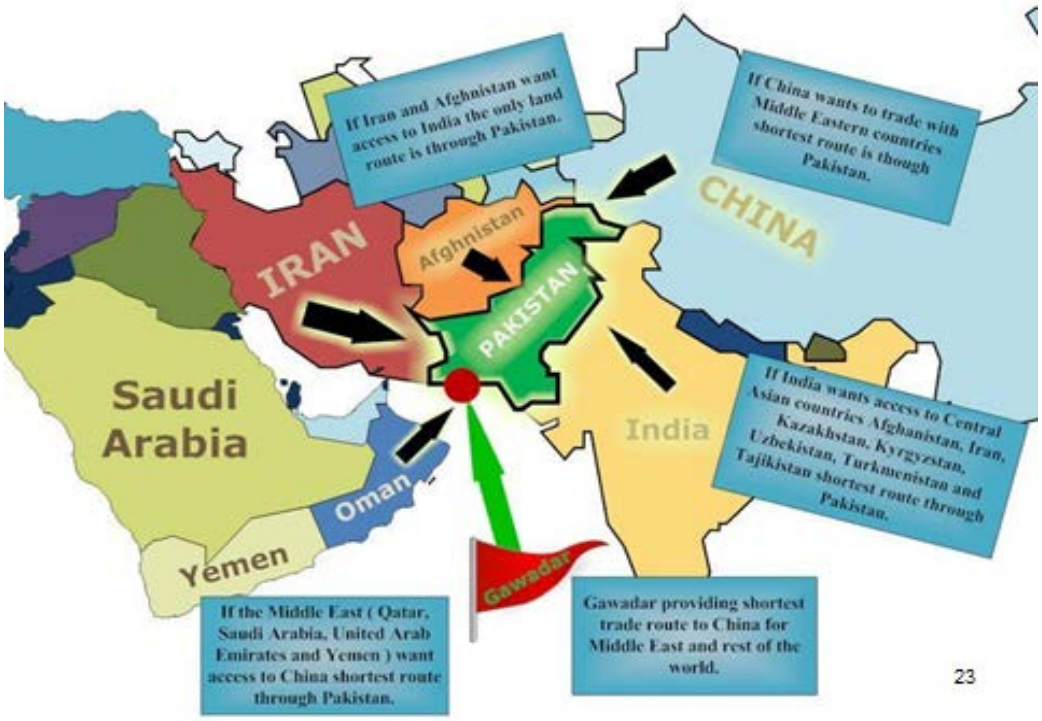
Existing literature reveals that a stable and prosperous Pakistan is crucial to preserving harmony and facilitating regional progress in South Asia. Benefitting from its geostrategic significance as a junction to and between regional countries, it can serve as an energy pivot as well as an energy corridor; see Figure 1. Unfortunately, such transnational energy projects come with a flip side of the story. Elizabeth Mills explains its significance: "How Pakistan pursues its regional energy options … will either increase potentially destabilizing geopolitical competition among regional actors or contribute to new collaboration, strengthening regional ties."[22] If handled sensibly, economic opportunities in transnational projects may resolve the regional security dilemma, stabilize the region, and ultimately contribute towards global peace.

[20] Nawaz Sharif, "Terrorism, Power Issues Keep Nawaz Perplexed," *Dawn News*, March 22, 2015, http://dawnnews.pk/.

[21] Ioannis N. Kessides, "Chaos in Power: Pakistan's Electricity Crisis," *Energy Policy* 55, no. C (2013): 275, http://econpapers.repec.org/article/eeeenepol/v_3a55_3ay_3a2013_3ai_3ac_3ap_3a271-285.htm.

[22] Mills, "Pakistan's Energy Crisis," 4.

Figure 1. Geostrategic Significance



Pakistan sits on the crossways between China and the Middle East and between South and Central Asia. Therefore, forming partnerships in the regional energy market makes sense in terms of securing their own energy needs and at the same time benefiting from the transit royalties. Source:Shafiq-ur-Rehman, "GeoStratigic Impportance of Pakistan," January 21, 2014. www.primeinstitute.org/uploads/.../pak-china_economic_corridor-_1.pdf.

However, in regard to energy solutions, it is easier said than done. Literature on Pakistan's energy sector policies reveals a number of agreements with potential partners and at-length talks, but no significant output. There have been a lot of deliberations, sometimes trailed by memoranda of understanding (MoU). However, the outcome of deals has always remained short of what dialogue or MoU promises. Pakistan desperately needs to develop an energy vision which has absolutely sellable prospects for all of the regional and international stakeholders.

Pakistan's foreign policy initiatives need to be redeveloped to foster better relations with its regional and international community and its own long-term national interests. The United States will remain a significant player in this regard. Ebinger writes: "This is going to be difficult, given domestic anti-American sentiment coupled with

Pakistan's interests in furthering relations with Iran. Still, Pakistan should not forget that the United States can, should it choose, give it a lot of support, both as a partner and a lobbying force within the international community."[23] Therefore, Pakistan needs to create conducive environment domestically as well as internationally in order to reap the benefits of energy security.

D. PROBLEMS AND HYPOTHESIS

This thesis hypothesizes that policy and institutional-level reforms are critical to addressing the energy crisis. Instead of being over-ambitious, these policies need to be binding, implementable, and futuristic. Institutions must be held accountable. There is a dire need to streamline the management, capacity building, and eliminating the issues of institutional overlap. Presently, "six ministries and forty-two agencies are involved in Pakistan's energy policy making and provision. Successive administrations have added task forces, created special adviser posts, and one-off commissions."[24] This thesis also hypothesizes that Pakistan's economy is the worst affected by the acute energy shortfall.

Further, it hypothesizes that internal security challenges and financial constraints are the major impediments to energy development. Most of Pakistan's domestic energy deposits are located in challenging zones, whether in terms of financial investment, infrastructure availability, or the security situation. Coal reserves are in the Thar Desert, which lacks infrastructure, and known oil and gas reserves are in Baluchistan and Khyber Pakhtunkhwa (KPK), where the security situation is adverse. Similarly, the volatile situation in Afghanistan is impeding the development of transnational projects. Therefore, internal and regional stability will be instrumental in tapping both domestic and regional energy resources.

Finally, this thesis hypothesizes that regional energy projects are vital for Pakistan. The country's geostrategic location offers it a unique opportunity to act as a linchpin between the energy-rich states of Central Asia and the Persian Gulf, as well as

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[23] Charles K. Ebinger, *Energy and Security in South Asia: Co-operation or Conflict* (Washington, DC: Brookings Institution Press, 2011), 81.

[24] Mills, "Pakistan's Energy Crisis," 6.

the emerging economies of southern and eastern Asia. Why not the rest of the world as well? With implementation of these transnational pipeline projects, Pakistan will not only substantively satisfy its own energy needs, but also serve as an energy corridor. These prospects are absolutely sellable to energy-producing and participating countries, but the daunting task of aligning the key regional players lies ahead. To achieve optimum results, effective foreign policy has a greater role to play. On one hand, regional energy partnerships may yield broader regional cooperation, peace, and stability, and on the other, they may put the region in turmoil due to competing interests of countries such as the United States, Russia, Iran, Saudi Arabia, and India.

E. METHODS AND SOURCES

Ultimately, this research project aims to reach conclusions, based on the opinions of energy experts, that not only satisfy Pakistan's energy needs but also make it an energy hub and corridor by tapping its regional resources. This thesis attempts to achieve this in the following ways: taking stock of available domestic energy resources and shortfalls, examining why policies have not worked and alternative energy means have not been explored, and developing a framework for achieving self-sufficiency in the energy sector.

While discussing Pakistan's domestic energy resources, this thesis begins with an overview of the available energy mix in Pakistan and also highlight the pattern of supply and demand over a period of time. It also looks into the economic implications of the present excessive shortfall, along with future challenges. In arguing why policies did not work, this thesis explores whether policies were practical, if institutions had the capacity to implement them, whether required infrastructure and financial backing was available, or if during different regimes they remained only a political slogan. The thesis also focuses on the variety of energy resources projects—both domestic and regional—that mostly remained short of realization.

Thereafter, together with the regional relations and security paradigm, this thesis explores the prospects of regional oil and gas pipeline projects, how they can be implemented, and what prospects they will have for the region's security and prosperity.

This thesis discusses how Pakistan can assume a leading role in the process and formulates a set of conclusions to overcome the energy crisis.

An analysis of the statistical aspects of Pakistan's energy resources is not used; however, quantitative data regarding various sources of energy are presented to lay the building blocks of study and to examine the gravity of the energy crisis, such as the gap between supply and demand. Due to the country-specific and limited nature of the subject, few published books are accessible. Most of the research used for this report comes from official government documents, seminars, presentations, and scholarly and peer-reviewed journals and articles. However, a number of additional publications are presented to evaluate the effects of multi-lateral regional and global relations in pursuit of a regional energy system and energy trade.

F. THESIS OVERVIEW

This thesis consists of five chapters. Chapter I lays the foundation of research work, and Chapter II presents an overview of Pakistan's existing energy resources, current energy mix, and the potential of renewable energy technologies. Chapter III discusses a range of energy sector challenges—institutional, governmental, political, and financial—that are detrimental to achieving energy security. Chapter IV explores Pakistan's options for exploiting the opportunities of transnational gas pipeline projects and the import of Liquefied Natural Gas (LNG) to diversify its energy mix and achieve energy security. This chapter also highlights the possibility of improving Pakistan's national and regional security situation due to perceived mutual economic interdependence, while satisfying their respective growing energy needs. Finally, Chapter V concludes the thesis, based on the opinions of experts in the energy sector.

II. PAKISTAN'S CURRENT ENERGY SCENARIO AND POTENTIAL

In the past decade, Pakistan's energy demand has increased by approximately 45 percent. On the contrary, energy production has followed a flatter trajectory, thereby increasing the demand and supply gap enormously. If this phenomenon continues for the next couple of decades, the energy sector will be unsustainable. The state of Pakistan's current energy resources and domestic potentials is discussed in this chapter.

Pakistan's current energy scenario reflects the following:

> During 2013–14 Pakistan's total energy availability was 66.015 million tons of oil equivalent (mtoe), of which 45.251 mtoe (i.e. 68.54%) was indigenous production while 20.764 mtoe (31.46%) was imported. The domestic energy sources comprised natural gas, hydel power, about one third of our crude oil supply, and small quantities of coal and nuclear energy. Imported energy mainly comprised petroleum and petroleum products.[25]

Pakistan's current energy mix is not diversified; furthermore, heavy reliance on imported fuel leaves no flexibility in addressing the energy shortages. Pakistan's current energy mix consists of the following sources:

- Natural gas **49.5%**
- Oil **30.8%**
- Hydel energy **12.5%**
- Coal **6.5%**
- Nuclear, LPG, & imported electricity **0.7%**[26]

A. OIL

Domestically, an average 12–13 million tons of oil is refined in the country per year. The largest oil refinery is the "Pak-Arab Refinery Complex (PARCO), which

25 Pakistan Energy Yearbook. "Oil Refineries in Pakistan." *Ministry of Petroleum and Natural Resources.* Government of Pakistan, 2012, 92.

26 Ibid.

became operational in late 2000, with 95,000 bbl/d of refining capacity. The majority of produced oil comes from proven reserves located in the southern half of the country, with the three largest oil-producing fields located in the Southern Indus Basin."[27] In 2006, domestic crude oil production fell to an average of 58,000 bbl/d. Hence, due to its meager domestic oil production, the country is heavily reliant on imported oil to catch up with its energy demand. Currently, Pakistan imports approximately one-third of its primary energy needs, principally through the external purchase of over 400,000 barrels of petroleum products per day, at a cost of approximately $15 billion per year. Nearly 90 percent of the imports are used to fuel the power sector, which previously ran on natural gas. In 2011, the Pakistan Institute of Petroleum forecast that energy imports would grow to $50 billion or more by 2025.[28] For the bulk of its oil imports, Pakistan is dependent upon the Middle East (ME), with the Kingdom of Saudi Arabia (KSA) in the lead role. The latest data available on oil reserves shows a production of approximately 633 million barrels and remaining proven recoverable oil reserves of 314 million barrels. Pakistan currently produces around 10.34 million tons of oil from local refineries per year.[29]

B. NATURAL GAS

Historically, oil and gas have been a major source of energy since the time of British rule in the subcontinent. Well exploration in this region (now Pakistan) dates back to 1887, when the first well was drilled in Punjab Province, Mianwali District. Subsequently, a series of well drilling continued in Baluchistan. Later, exploration spread to other regions of the country. In 1952, 10 trillion cubic feet (Tcf) of estimated gas reserves were discovered at Sui in Baluchistan Province, which still contributes a major share to the energy sector. After the Sui gas field discovery, agreements were signed with numerous international companies: Standard Vacuum Oil (1954), Hunt International Oil (1955), Shell Oil (1956), Sun Oil (1957), and Tidewater (1958).[30] However, these

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[27] Pakistan Energy Yearbook. "Oil Refineries in Pakistan." *Ministry of Petroleum and Natural Resources.* Government of Pakistan, 2012, 39.

[28] Ibid., 25.

[29] Ibid., 27.

[30] Ieda Gomes, "Natural Gas in Pakistan and Bangladesh: Current Issues and Trends," *Oxford Institute for Energy Studies*, June 2013: 11.

franchise agreements did not yield the desired results and Pakistan's government decided to explore the hydrocarbon resources through two state-owned companies: Oil and Gas Development Corporation (OGDC) and Pakistan Petroleum Limited (PPL). Presently, government-owned shares account for 71 percent, private investment for 22 percent, and Employees Empowerment Trust of PPL for 7 percent of the shares.[31]

In Pakistan, the energy matrix is dominated by natural gas; it accounts for almost 50 percent of overall energy supplies. Besides fueling millions of vehicles, natural gas is the prime source of energy for commercial and residential sectors. Pakistan ranks twenty-first in the world as a major gas consumer. Its use of gas as a source of energy is comparable to France's use. Until 2005, Pakistan's gas production was sufficient to meet its needs.[32] Unfortunately, lack of alternatives in the energy sector, the issue of subsidies, and the absence of realistic forecasting, coupled with institutional and policy constraints, resulted in a widening gap between supply and demand. Gas production in Pakistan is mainly limited to onshore drilling; offshore discoveries remain short of expectations due to unattractive fiscal terms and maritime rivalry in the neighborhood. According to Pakistan's Ministry of Petroleum and Natural Resources (MPNR), "the remaining reserves of natural gas are 27.5 Tcf (gas) and 342 million barrels (oil)."[33] The organizational structure of MPNR is given in Figure 2.[34]

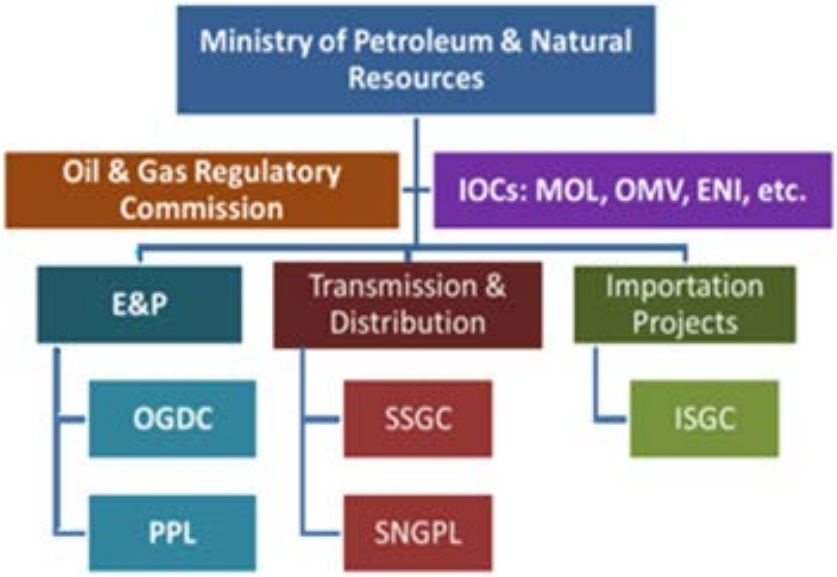
31 Pakistan Oil and Gas Regulatory Authority (OGRA), Islamabad, Annual Report, 2013.

32 Ibid.

33 Gomes, "Natural Gas in Pakistan and Bangladesh," 8.

34 Ibid., 14. The upstream activities in the oil and gas sector are administered and regulated through the Directorate General of Petroleum concessions (DGPC) under the policy wing of the Ministry of Petroleum and Natural Resources (MPNR). The policy wing also comprises the Directorate General of Gas (DG Gas), Directorate General of Oil (DG Oil), and Directorate General Special Projects (DGSP) to provide support to the government in formulation of policies for midstream and downstream of the oil and gas sector.

Figure 2. Organizational Structure



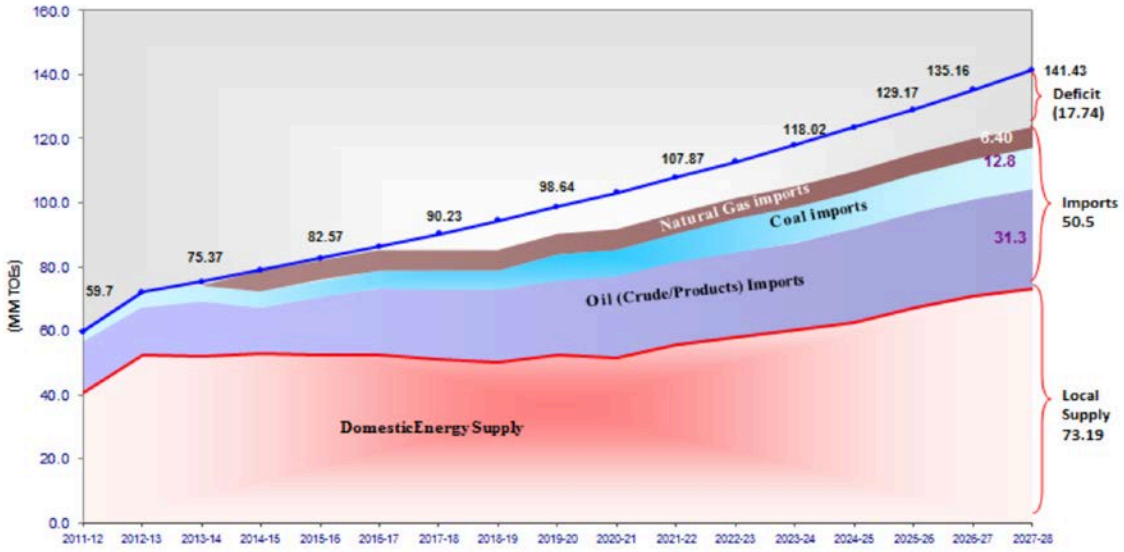
Source: OGRA, MPNR, SSGC

Source: *Wikipedia*, "Ministry of Petroleum and Natural Resources Pakistan," accessed November 16, 2015. https://en.wikipedia.org/wiki/Ministry_of_Petroleum_and_Natural_Resources_%28Pakistan%29.

Over the last few years, demand for natural gas is sliding up by six percent as compared to production, which is flat or even moving downwards. The supply-demand gulf is constantly enlarging. As per the data collected by the Pakistan Institute of Petroleum (PIP), "the energy deficit in Pakistan will reach nearly 15 Million Tons of Oil Equivalent (MTOE) by 2020 even taking into account the projected imports of natural gas."[35] See Figure 3.

[35] Pakistan Institute of Petroleum (PIP), Islamabad, Annual Report, 2013.

Figure 3. Domestic Energy Supply



Source: Gomes, "Natural Gas in Pakistan and Bangladesh," 10.

According to the latest official estimates, the real-time availability and consumption of natural gas in Pakistan measures approximately 40 billion cubic meters per annum (Bcma).[36] If an unmet quantity of 15 Bcma is added to this measurement—which includes fuel oil utilized for running power plants and industrial use, along with 3–4 Bcma unutilized capacity—then the resulting shortfall is around 15–19 Bcma.[37] Based on projected GDP growth of 6.5 percent, PricewaterhouseCoopers (PwC) concluded that demand will rise to 65–70 Bcma by the year 2020, resulting in a supply-demand gap of 40–50 Bcma, which will be equivalent to current consumption.[38] It is evident that in the near future, a huge shortfall in gas supplies will be unavoidable. In an effort to mitigate this looming threat, the materialization of transnational gas pipeline projects, including importation of LNG, is indispensable. Even if these projects find manifestation,

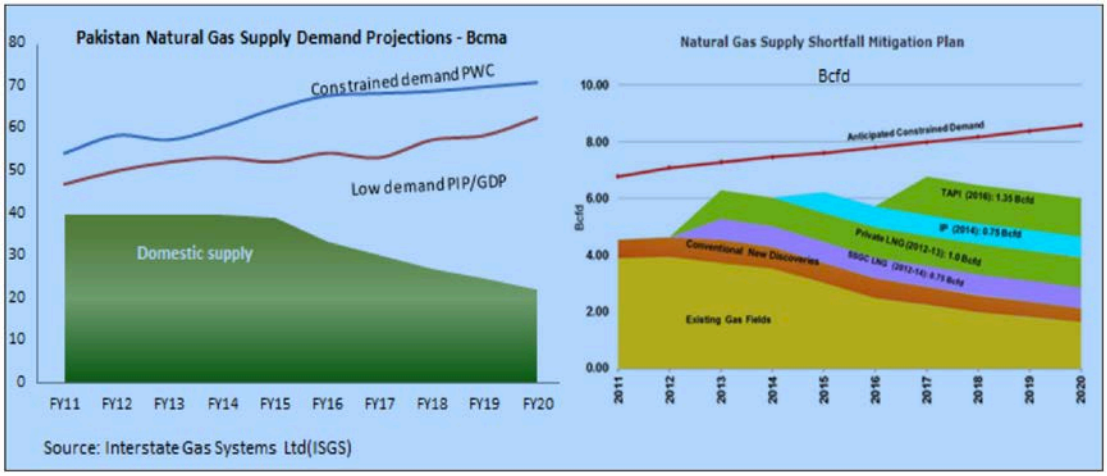
[36] Billion cubic meters of natural gas (Bcm) is a measure of natural gas production and trade. Depending on implied standards, this measure may represent different values of energy content. According to the standard defined by the International Energy Agency, it corresponds in average to 38.2 pet joules (1.06×1010 kWh) of energy in the case of Russian natural gas and 41.4 pet joules (1.15×1010 kWh) of energy in the case of Qatar's natural gas.

[37] ISGC website: Conservative Scenario (PIP-Pakistan Institute of Petroleum), Optimistic Scenario: PwC analysis (Pakistan Interstate Gas Systems: http://www.isgs.pk/energy_sector .php?spid=22&mid=2)

[38] ISGC website: Optimistic Scenario: PwC analysis

diversifying Pakistan's energy mix will still be necessary to achieve energy security (see Figure 4).

Figure 4. Natural Gas Supply Demand



Source: Gomes, "Natural Gas in Pakistan and Bangladesh," 14.

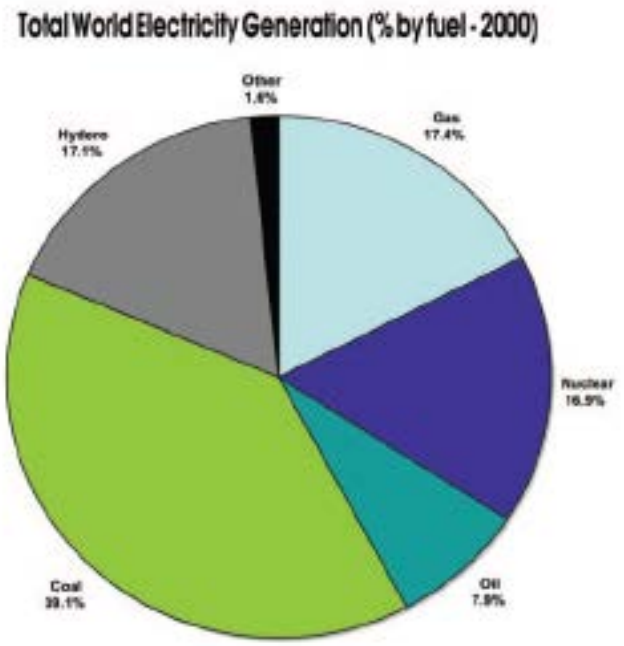
C. COAL

Despite many advances in the field of energy, coal still retains the biggest chunk of all energy resources in the world—almost 39 percent of total power generation in the world. Coal has added advantages. It is available in abundance, comparatively cheap, and safe in storage and transportation. In terms of their reliance on coal as a source of energy production, the leading countries are as follows: Poland produces over 95 percent of electricity with coal, South Africa produces about 92 percent, China produces 77 percent, and Australia produces 76 percent. Coal's use as a source of energy is increasing much more than any other form of energy—hydro, oil, gas, renewable, or nuclear—despite environmental concerns. Ejaz Ahmed Khan says: "Reliance on coal is increasing day by day specifically in developing countries."[39] He further writes: "According to World

[39] Khalid Mansoor, "How Coal Can Help Address Pakistan's Energy Crisis," in *Pakistan's Interminable Energy Crisis: Is There Any Way Out?*, ed. Michael Kugelman (Washington, DC: Woodrow Wilson Center Press, 2015), 41. Ejaz Ahmed Khan is a former secretary in the Coal and Energy Department.

Energy Outlook (WEO), future energy demand in emerging Asian countries will increase to 60% by 2020 as compared to 26% in 1980."[40]

Figure 5. Total World Electricity Generation



Source: Anwar, *Solutions for Energy Crisis in Pakistan,* 2013.

Currently in Pakistan, "coal plays a negligible role in its energy mix, although the country contains an estimated 3,362 million short tons (Mmst) of proven recoverable reserves."[41] Despite these huge, proven reserves, Pakistan utilizes only approximately 3.5 Mmst per year for energy production, which is a negligible amount in the country's current energy mix.

In 1992, the Geological Survey of Pakistan (GSP) and the United States Geological Survey (USGS) discovered massive coal deposits in Tharparkar (Thar) in Sind Province. This research program included drilling over two hundred holes, spread over an area of approximately 350 square kilometers:

[40] Ibid.

[41] Langdon D. Clough, "Energy Profile of Pakistan," in *Encyclopedia of Earth,* ed. Cutler J. Cleveland, 6, http://www.eoearth.org/article/Energy_profile_of_Pakistan.

Thar coalfield is spread over an area of more then, 9,000 sq. km. and passes 175.506 billion tons of coal. It is one of the largest coalfields of the World and is sufficient to meet fuel requirements of over a hundred years, if the basic infrastructure is established. The province of Sindh is endowed with huge coal deposits, estimated at 184.123 billion tons. Out of which, Thar coal deposit comprises 175. 506 billion tons, which constitutes around 99% of total coal deposits of the country. The coal deposits of Sindh (coal field-wise) are as quoted under:

Coal-field	**(Billion Tones)**
Lakhra, District Dadu	1.328
Sonda-Jherruck, District Thatta	7.112
Jhimpir-Metting, District Thatta	0.161
Badin	0.016
Thar	175.506
Total	**184.123**[42]

Pakistan has a great opportunity to benefit from these recently discovered coal resources. Munir writes: "A breakdown of the estimated value of energy resources in Pakistan in terms of U.S. $ in billion highlights that oil has an estimated value of 6 billion dollars, gas has 25 billion dollars, whereas, coal has an estimated value of 5,540 billion dollars."[43] With the discovery of the Thar coalfield reserves, Pakistan now ranks seventh among the top twenty countries possessing lignite coal reserves. Since the discovery, a number of countries have offered Pakistan potential partnerships in the exploration and development of the Thar coal project. Main contenders include the United States, Germany, China, the United Kingdom, and Australia. Such partnerships can only materialize if an enabling environment is created by constructing an institutional and physical infrastructure, and by initiating investor-friendly long-term policies.

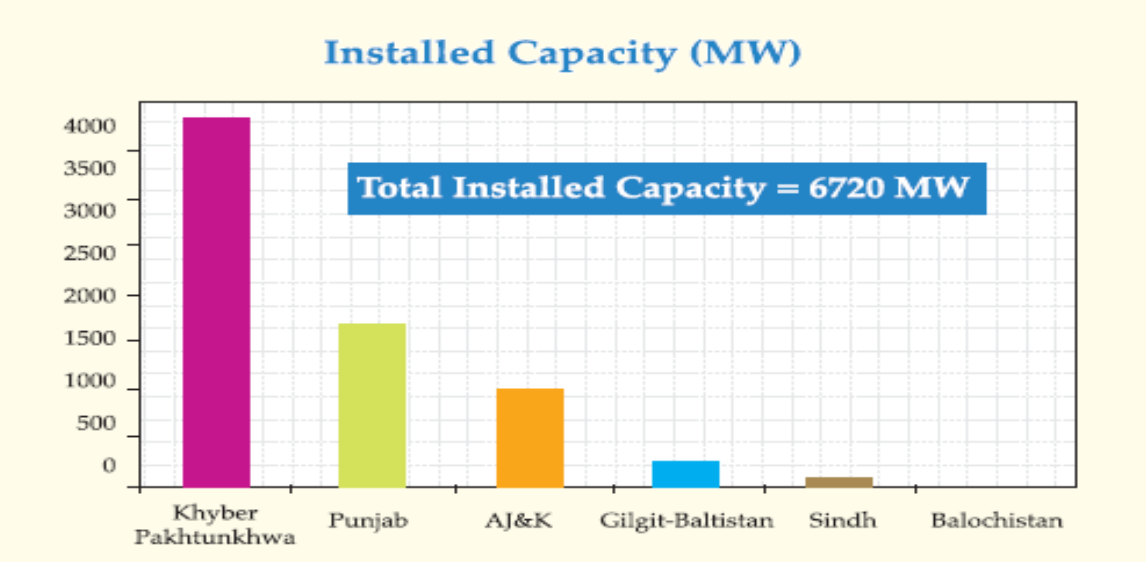
[42] Faiz Muhammad Shaikh, Muneer Ali Shah, and Anwar Ali Shah, "Energy Crisis in Pakistan: Thar Coal as an Alternative Solution," *New Horizons* 11, no. 1 (January 2012): 3.

[43] Dr. Munir Ali Shah is Dean of Faculty of Management Sciences and Information Studies, Greenwich University, Karachi, Pakistan.

D. HYDROELECTRICITY

Pakistan is blessed with a huge potential for hydroelectric power, which has the capacity to generate approximately 60,000 megawatts of energy against the current peak time requirement of only 21,000 megawatts.[44] Besides being environmental friendly, hydel-generated power is one of the cheapest sources of energy once it is put in place. Currently, only 11 percent of Pakistan's hydropower potential is being utilized, and the remaining 89 percent is untapped due to a number of factors that are discussed in Chapter II. The overall installed capacity, based on hydel projects, is just 6,720 megawatts. Major power-contributing plants are located at Terbela, Mangla, Warsak Dams, Guddu Barrage, and Chashma Canal. A regional-based summary of these projects is tabulated in Figure 6.

Figure 6. Total Installed Capacity



Source: Pakistan Private Infrastructure Board, *Hydropower Resources of Pakistan* (Ministry of Water and Power, Government of Pakistan, 2011), 7.

These hydropower projects are managed by different entities of the public sector, namely, Sarhad Hydel Development Organization (SHYDO), WAPDA, Water and Power Department of Gilgit-Baltistan, and Hydro Electric Board (HEB) in Azad Jammu and

[44] Umar K. Mirza et al., "Hydropower Use in Pakistan: Past, Present, and Future," *Renewable and Sustainable Energy Reviews* 12, no. 6 (2008): 107.

Kashmir (AJ&K). Existing installed projects, based on their managing sector, location, and generation capacity, are tabulated in Tables 1–4.

Table 1. Existing Hydropower Projects in Operation in Pakistan

Existing Hydropower projects in operation in Pakistan

S. No	Project Name	Location	Province	Capacity (MW)
A. WAPDA				
1	Tarbela	Indus River	Khyber Pakhtunkhwa	3478
2	Warsak	Kabul River, Peshawar	Khyber Pakhtunkhwa	240
3	Jaban (Malakand-I)	Swat River, Malakand	Khyber Pakhtunkhwa	20
4	Dargai (Malakand-II)	Swat River, Malakand	Khyber Pakhtunkhwa	20
5	Kurram Garhi	Kurram Garhi (Canal)	Khyber Pakhtunkhwa	4
6	Mangla	Jehlum River, Mirpur	AJ&K	1000
7	Ghazi Barotha	Indus River, Attack	Punjab	1450
8	Chashma	Indus River, Chashma	Punjab	184
9	Rasul	Chenab River, Rasul	Punjab	22
10	Shadiwal	Gujrat	Punjab	14
11	Nandipur	Upper Jehlum Canal, Gujranwala	Punjab	14
12	Chichoki Hydel	Upper Jehlum Canal, Sheikhupura	Punjab	13
13	PAEC Chashma Hydel	Chashma, Mianwali	Punjab	1.2
14	Renala	Lowerbari Doab Canal, Okara	Punjab	1
15	Satpara	Satpara River, Sakardu	Gilgit-Baltistan	16
16	Kar Gah Phase VI	Gilgit	Gilgit-Baltistan	4
			Sub Total	6481

Source: Water and Power Development Authority (WAPDA), www.wapda.gov.pk.

Table 2. Sarhad Hydel Development Organization (SHYDO)

B. SHYDO				
1	Malakand-III	River Swat, Malakand	Khyber Pakhtunkhwa	81
2	12 Small Hydel Projects less than 2 MW	Various location	Khyber Pakhtunkhwa	3.2
3	Reshun	Chitral	Khyber Pakhtunkhwa	2.8
			Sub Total	87

Source: Sarhad Hydel Development Organization (SHYDO). www.shydo.gov.pk.

Table 3. AJ&K Hydro Electric Board (HEB)

S. No	Project Name	Location	Province	Capacity (MW)
C. HEB–AJ&K				
1	Jagran	Jagran River/Neelum	AJ&K	30.4
2	Kathai	Kathai Nallah, Muzafarabad	AJ&K	3.2
3	5 Small Hydel Projects less than 2 MW	Various Location	AJ&K	3.1
4	Kundal Shahi	Jagran River / Neelum	AJ&K	2
			Sub Total	39

Source: AJ&K Hydro Electric Board (HEB), Government of AJ&K. www.electricity.ajk.gov.pk.

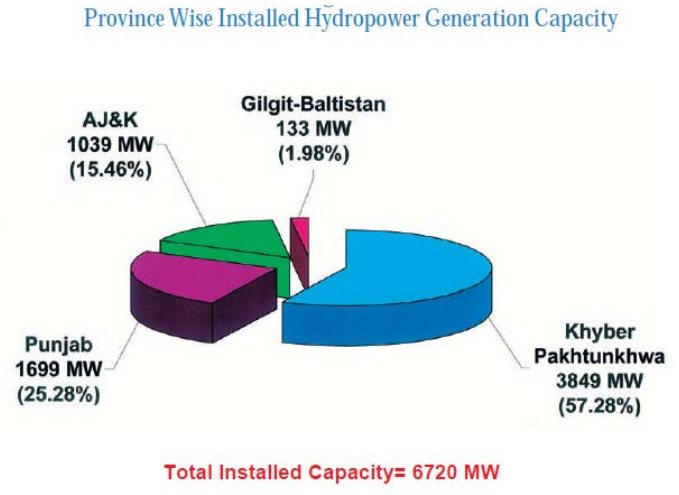
Table 4. Water and Power Department—Gilgit-Baltistan

D. WATER & POWER DEPARTMENT– GILGIT-BALTISTAN				
1	Naltar	Gilgit	Gilgit-Baltistan	18
2	Gilgit	Gilgit	Gilgit-Baltistan	10.63
3	Skardu-I	Skardu	Gilgit-Baltistan	6.96
4	Chilas-I	Chilas	Gilgit-Baltistan	5.62
5	Hunza	Hunza	Gilgit-Baltistan	5.13
6	Shyok	Shyok	Gilgit-Baltistan	4.85
7	Astore	Astore	Gilgit-Baltistan	3.11
8	Kachura Phase II	Skardu	Gilgit-Baltistan	3
9	Ghizar	Ghizar	Gilgit-Baltistan	2
10	Thak	Chilas	Gilgit-Baltistan	2
11	Phandar	Ghizar	Gilgit-Baltistan	2
12	Bordas	Ghanche	Gilgit-Baltistan	2
13	84 Small Hydel Projects less than 2 MW	Various Locations	Gilgit-Baltistan	47.7
			Sub Total	113
			GRAND TOTAL	6720

Source: Water and Power Department, Gilgit-Baltistan. Gilgit-Baltistan Secretariat, WSP Headquarters, Gilgit, www.gilgitbaltistan.gov.pk.

Of the total installed capacity of 6,720 megawatts, power produced by each province is explained in Figure 7.

Figure 7. Province Wise Installed Hydropower Generation Capacity



Source: Pakistan Private Infrastructure Board, *Hydropower Resources of Pakistan* (Ministry of Water and Power, Government of Pakistan, 2011), 12.

If institutional, political, and financial hurdles are overshadowed and even 25 percent of the current untapped potential is harnessed within the next two decades, the gap between supply and demand can be reduced to a manageable limit. However, this does not negate the necessity of building other energy sources—of increasing Pakistan's capacity to generate energy as well as diversifying its energy mix. Table 5 summarizes the existing public and private projects, along with solicited and raw sites.

Table 5. Summary of Hydropower Resources in Pakistan

Summary of Hydropower Resources in Pakistan

Province/ Territory	Projects in Operation (MW)	Projects Under Implementation			Solicited Sites (Projects with Feasibility Study Completed) (MW)	Projects with Raw Sites (MW)	Total Hydropower Resources (MW)
		Public Sector (MW)	Private Sector (MW)				
			Province Level	Federal Level			
Khyber Pakhtunkhwa	3849	9482	28	2370	77	8930	**24736**
Gilgit-Baltistan	133	11876	40	-	534	8542	**21125**
Punjab	1699	720	308	720	3606	238	**7291**
Azad Jammu and Kashmir	1039	1231	92	3172	1	915	**6450**
Sindh	-	-	-	-	67	126	**193**
Balochistan	-	-	-	-	1		**1**
TOTAL	**6720**	**23309**	**468**	**6262**	**4286**	**18751**	**59796**

Source: Water and Power Development Authority (WAPDA), www.wapda.gov.pk.

Although developing additional hydroelectric sources has always been on the table, financial and political constraints have always overshadowed the necessity and significance of these power-generation plans. The Private Power and Infrastructure Board (PPIB) is working on the feasibility study of numerous small-scale hydropower projects.

If these projects materialize, a considerable amount of electricity will be added to the grid.

E. OTHER RENEWABLE ENERGY (RE) SOURCES

IEA statistics indicate that worldwide, renewable energy is growing at a fast pace. In 2011, about 21 percent of the world's electricity generation was from renewable energy (including hydropower), with a projection for it to grow to nearly 25–30 percent in 2040.[45] However, efforts in Pakistan to substitute fossil fuels with renewable energy sources (excluding large hydro) in order to diversify the current energy mix, or even to reduce the huge gap between supply and demand, have not succeeded for many reasons.

The 2002 Power Policy of Pakistan emphasizes the need and future prospects of building RE resources, but the strategy and framework for its execution are missing. Unfortunately, "the resource planning and acquisition processes have ignored the value of renewable energy resources."[46] Environmental and long-term economic benefits of RE technologies have largely been disregarded in the process of energy forecasting.

In May 2003, the Alternative Energy Development Board (AEDB) was established. In the field of RE, it is the only agency that represents the federal government. According to the mandate of AEDB, its primary objective is "to facilitate, promote and encourage development of Renewable Energy in Pakistan," with a "mission to introduce Alternative and Renewable Energies (AREs) at an accelerated rate."[47] In 2006, the Ministry of Water and Power took over the administrative control of AEDB. The AEDB is responsible for:

- Implement policies, programs, and projects through private sector in the field of alternative and renewable energy
- Assist and facilitate the development and generation of ARE to achieve sustainable economic growth

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[45] Africa Energy Outlook - World Energy Outlook Special Report, 21. https://www.iea.org/publications/.../WEO2014_AfricaEnergyOutlook.pdf

[46] United Nations Development Program, "Commercialization of Wind Power Potential in Pakistan" (Kuala Lumpur, Malaysia: United Nations Office for Project Services, 2003).

[47] M. Ashraf Chaudhry, R. Raza, and SA Hayat, "Renewable Energy Technologies in Pakistan: Prospects and Challenges," *Renewable and Sustainable Energy Review* 13, no. 6 (2009): 1659.

- Encourage the transfer of technology and develop an indigenous manufacturing base for ARE Technology
- Promote the provision of energy services that are based on ARE resources
- Undertake ARE projects on a commercial scale (AEDB Act 2010)[48]

AEDB has been given the mandate by the government of Pakistan (GoP) to develop a renewable energy resource with a capacity to contribute at least 10 percent toward the total generation capacity of the country by 2030.[49] To begin with, wind, solar, and biogas are the selected technologies. Pakistan has a huge potential for harnessing these environmentally friendly energy resources, but unfortunately, until recently, no wind farms at a commercial level are functional and only a few micro-wind turbines are in use as a pilot project. Similarly, few rooftop Photovoltaic (PV) or commercial and household thermal systems are in place.

Like other forms of alternative energy, use of biomass as source of energy production has remain shorot of implementation. Currently, "sugar mills in the country use bagasse for cogeneration purposes and have recently been allowed to sell surplus power to the grid stations."[50] Commercially, no other significant "biomass-based technology is presently employed for energy production/use in the country, beyond experimental deployment of biogas digesters, improved cook stoves, and other small scale end-use applications."[51] Biogas digesters, when used in countryside households, were considered a great success. However, due to a lack of futuristic planning and policies and the withdrawal of external subsidies, any perceived potential could not be achieved.

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[48] Ministry of Water and Power, "Policy for Development of Renewable Energy for Power Generation," (Islamabad: Government of Pakistan, 2006).

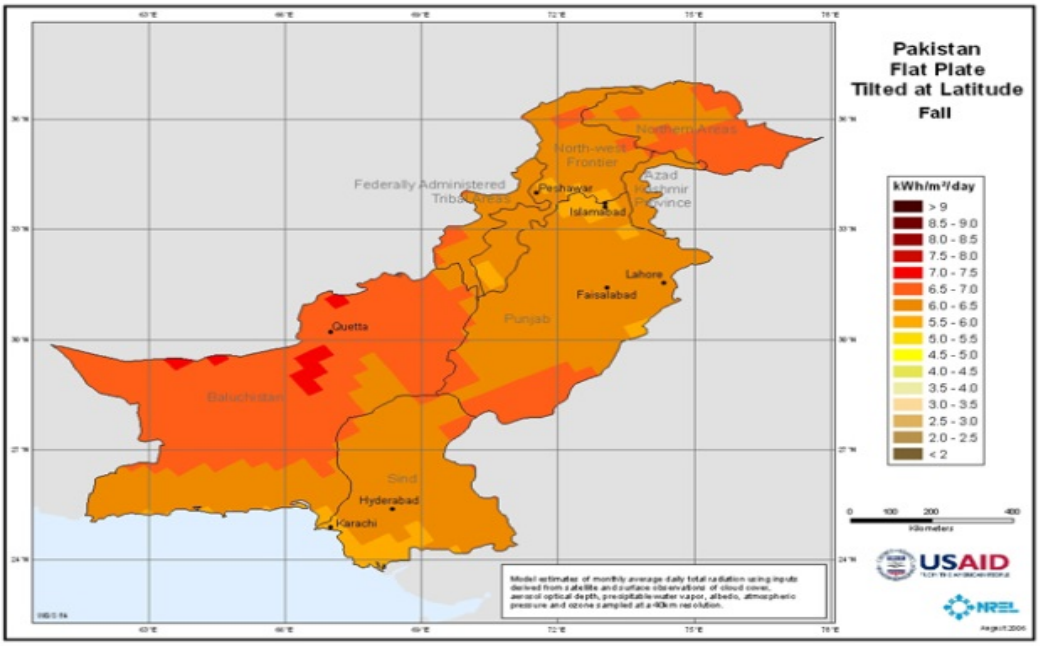
[49] Vaqar Ahmed, "Economics of Energy Mix: The Case of Pakistan," in *Solutions for Energy Crisis in Pakistan*, ed. Mushir Anwar (Islamabad, Pakistan: Islamabad Policy Research Institute, 2013), 40.

[50] Bagasse is a byproduct of sugar cane and is a common fuel in the sugar industry. In addition, bagasse is also used as a fuel in the treacle-making process in Pakistan. The production of bagasse is 340 kilograms per 1,000 kilograms of cane, crushed at an average moisture content of 50 percent.

[51] Pakistan Society of Sugar Mills Association (PSSMA), Annual Report 2013, and Summary of Laboratories Reports.

Amjad Ali Awan, chief executive of the AEDB, recently claimed that with the cooperation of USAID, the National Renewable Energy Laboratory (NREL) has developed solar and wind resource maps for macro-level planning and execution as shown in Figures 8 and 9.[52] Similarly, the World Bank is also financing mapping initiatives in the field of RE, and spatial planning and mapping has been initiated to tap the biomass, solar, and wind energy resources.[53] In a nutshell, to harness the potential of RE, key issues must be addressed, including a dedicated effort to overcome the institutional, political, financial, and policy constraints already discussed.

Figure 8. Pakistan Flat Plate Tilted at Latitude Fall

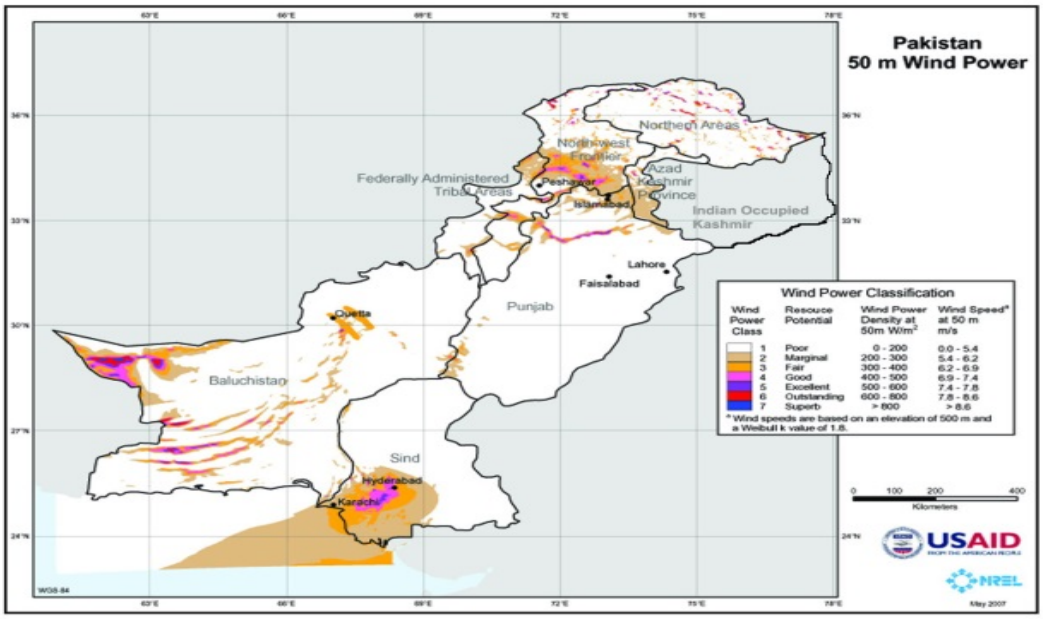


Source:Pakistan Resource Maps and Toolkit, *National Renewable Energy Laboratory*, http://www.nrel.gov/international/ra_pakistan.html.

[52] The National Renewable Energy Laboratory, located in Golden, Colorado, is the United States' primary laboratory for renewable energy and energy efficiency research and development.

[53] Alternative Energy Development Boards' policies for Renewable Energy in Pakistan, June 10, 2015.

Figure 9. Pakistan 50 m Wind Power



Source Pakistan Resource Maps and Toolkit, *National Renewable Energy Laboratory*, http://www.nrel.gov/international/ra_pakistan.html.

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III. ENERGY SECTOR CHALLENGES: INSTITUTIONAL, GOVERNMENTAL, AND POLITICAL OBSTACLES

As of late 2014 and early 2015, situations demonstrate that the energy crisis in Pakistan is deeply entrenched, with devastating consequences and manifestations. Besides Pakistan's growing demand for energy, inefficient institutional and organizational structures are major factors contributing to this mess. Therefore, it is important to realize that simply building additional energy infrastructure and enhancing the volume of energy generated will not help Pakistan alleviate the simmering issue of its energy crisis. Keeping in mind the total current generation capacity versus peak time demand, which are almost the same, it is safe to assume that shortcomings of management (including governmental, institutional, and political hurdles) are the key impediments to stabilizing the situation. The current shortfall between supply and demand of about 5,000 megawatts is primarily attributed to the management inefficiencies that are being discussed here.[54] In February 2014, the ADB report stated that "the [energy] problem has been exacerbated by existing generating capacity not being fully employed. In May 2013, out of eleven public sector thermal power plants, seven were completely shut down and the rest were not running at full capacity due to fuel shortages."[55]

The energy sector in Pakistan lacks cohesiveness and unified authority at the planning and decision level, which is necessary for long-term, futuristic, and sustainable

[54] Malik Musadiq, "Pakistan's Energy Crisis: Challenges, Principles, and Strategies," in *Pakistan's Interminable Energy Crisis: Is There Any Way Out?*, ed. Kugelman Michael (Washington, DC: Woodrow Wilson Center Press, 2015), 27.

[55] Asian Development Bank, Pakistan: Energy Sector Restructuring Program, February 2014.

policies.[56] The Oil and Gas Regulatory Authority (OGRA) is responsible for the regulation of oil and gas; whereas, according to section 7(3)(a) of the act, the "National Electric and Power Regulatory Authority (NEPRA) is exclusively responsible for determining tariff, rates, charges and other terms and conditions for supply of electric power services by the generation, transmission and distribution companies and recommend to the Federal Government for notification."[57] Similarly, hydel power projects are managed by the Water and Power Development Authority (WAPDA). The institutional fragmentation of various components of energy sources like fuel, electricity, and water is prominent. ADB's Pakistan director, Rune Stroem, who is also co-chair of the Energy Sector Task Force, notes that:

> Responsibilities and accountabilities in Pakistan's energy sector are dispersed to the point that they are ineffective. … This fragmentation blocks integrated planning and budgeting in the energy sector, distorts efficiency, creates disequilibrium among the subsectors, and generates disharmonious regulatory structures. Energy security simply cannot be achieved unless it is treated as an integrated item.[58]

This lack of executive-level singular planning and one decision-making body has always resulted in ad-hoc measures and piecemeal policies. These policies were neither effective nor adequate to achieve energy security. Mirza Hamid Hassan, a former secretary of the Ministry of Water and Power, says: "Important issues such as the close linkage between various forms of energy, the affordability and sustainability of energy supplies, the linkage between choice of technologies and resultant cost of energy etc., never received the attention of our policy makers and planners in the absence of a

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[56] The U.S. government conducted a three-part study of Pakistan's policy-making infrastructure in mid-2008. Dawn reported the cables in full in July 2011, which revealed the U.S. view that the country's power problems were the result of "the haphazard mix of horizontally and vertically placed institutions, which comprise the energy policy making sector of Pakistan." Further to this, the cables referred to "the complex maze of GOP [government of Pakistan] policy makers who cannot co-ordinate Pakistan's energy policy due to overlapping and contradictory authorities." A lack of a distinct policy line, and confusion over decision making, means that basic issues like raising well-head prices (the price the producer charges for gas or petroleum) to encourage exploration and extraction are not pursued or are pursued painstakingly slowly. www.dawn.com/.../secret-us-cables-accessed-by-dawn-through-wikileaks-us- examined-haphazard-mix-of-pakistans-energy-bureaucracy

[57] Remarks by Chief Justice Supreme Court of Pakistan, during hearing on Rental Power Projects scam.

[58] Energy Task Force, *Integrated Energy Sector Recovery Report & Plan*, (Pakistan, Islamabad: Energy Task Force, October 2010), vi.

comprehensive policy."[59] Therefore, it can be safely concluded that the current energy crisis is largely the product of policy makers and planners failing to forecast and construct viable long-term energy policies, and instead introducing piecemeal and short-term measures. Some of the policies floated from time to time are quoted as follows:

- Policy Framework and Package of Incentives for Private Sector Power Generation Projects in Pakistan 1994 (popularly known as 1994 Power Policy)—formulated to meet the growing power shortage through private sector investment
- Policy for Power Generation Projects 2002—formulated to improve upon the 1994 policy and to encourage private sector to invest in hydropower projects
- Policy Framework for New Captive Power Producers—formulated by PEPCO
- Policy for Development of Renewable Energy for Power Generation 2006
- Draft Renewable Energy Policy of Pakistan 2012
- Punjab Power Generation Policy 2006 (revised in 2009)
- Petroleum policies floated from time to time, including Petroleum Exploration and Development Policy 2012.[60]

Historically, "Pakistan's power sector was organized into two state-owned, vertically integrated utilities," which are explained in Appendix A. The institutional organization of Pakistan's power structure is discussed in Appendix B.[61]

The management and governance of Pakistan's energy sector are other big issues, and in power economy this is not a framework that can sustain itself. According to different sources, the average losses in transmission and distribution (T&D) amount to 20–25 percent. Out of this, the biggest loss is attributed to distribution. This issue is not Pakistan-specific; India surpasses Pakistan with average T&D losses of 31–32 percent. However, contrary to Pakistan, Indian authorities are seriously concerned about the energy issue and are taking concrete measures to minimize T&D losses. For example, in

59 Mirza, "An Overview of Pakistan's Energy Sector," 10.

60 Ibid., 13.

61 Vucetic and Adamantiades, "Power Sector Reforms in Pakistan," 106–107.

New Delhi, they have achieved remarkable success by stripping down T&D losses to around 21–22 percent.[62] Even the most developed countries of the world face T&D losses, but their percentage is much less than third world countries. In addition to T&D losses, revenue recovery is another pitfall. Recovery of revenue from consumers in both private and public sectors is almost half of the billing totals for power producers. Old and obsolete meters and billing systems also contribute to inefficiencies by making it very easy for anybody to tamper with the meters. In fact, meter readers themselves interfere with the billing system. Clearly, the current system lacks accountability and transparency. The resulting outcome is the accumulation of circular debt.[63] This circular debt affects not only the power sector itself; rather, a liquidity crunch sparks a chain reaction, resulting in the interruption of the oil and gas sectors' supply chain and the weakening of financial organizations.

The lack of desired and possible energy mix is also largely attributed to the energy sector's institutional inefficiencies. Dr. Vaqar Ahmed notes,

> Globally, the average usage for oil of energy generation stands at five percent compared with Pakistan where the same number stands at a whopping 32 percent (2011). While the world uses on average 21 percent gas for energy generation, Pakistan continues to drain its gas reserves as the same number is at 48 percent. As the world searched for cheaper and more reliable sources of energy the reliance increased towards coal (contrary to what environmental experts would have suggested). Today, due to its low price global average usage of coal in energy generation stands at 40 percent and the same number for Pakistan is seven percent.[64]

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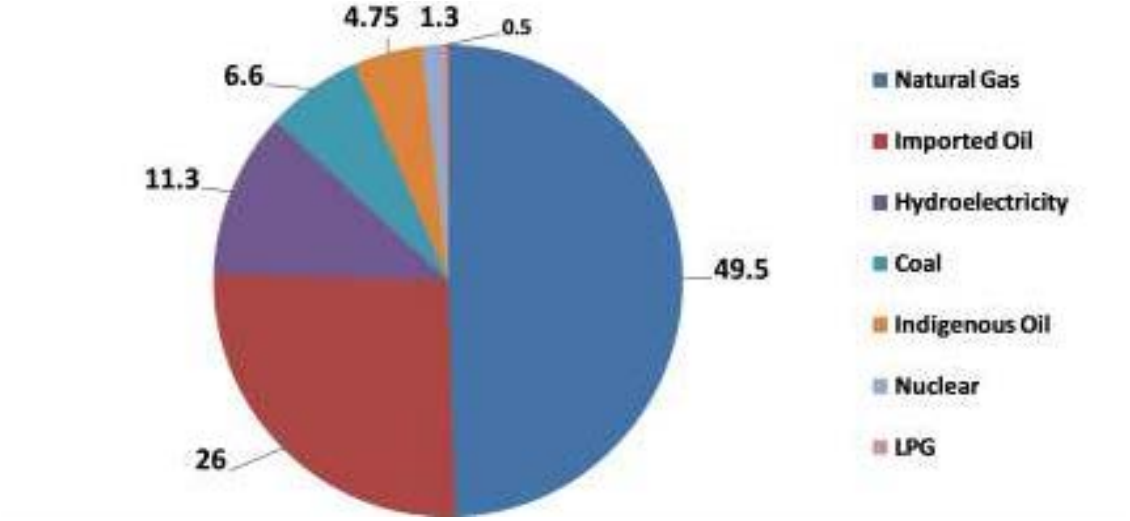
[62] The lowest T&D rates are in Japan (4 percent). Denmark, Germany, Singapore, France, Australia, Canada, China, South Africa, Switzerland, and Sweden are at 6 percent. The United States, United Kingdom, and Italy are at 7 percent. Thailand's T&D losses register at a remarkably low level, given its low level of economic development. Its rate is 10.52 percent.

[63] Circular debt reflects the difference between high power generation cost and low electricity bills. The circular debt accumulates as the government's subsidy bill balloons. Last year, the government settled a 480 billion-rupee (Dh17.5bn) circular debt after clearing dues to the Independent Power Producers (IPPs) to avoid sovereign default. However, the circular debt has now reached a historic high of 580bn rupees, pushing the government back to the situation it was facing a year ago.

[64] Vaqar , "Economics of Energy Mix," 39.

This analysis and Pakistan's current energy supply mix, as shown in Figure 10, demonstrate two factors: (1) total failure or absence of evidence-based planning and (2) desperately needed energy sector reforms.

Figure 10. Energy Supply Mix 2012–2013



Source: Pakistan Energy Yearbook, "Oil Refineries in Pakistan," *Ministry of Petroleum and Natural Resources*, Government of Pakistan, 2012, 6.

The worsening energy crisis is further compounded by a lack of consensus between the provinces and the central government due to the politicization of power projects on ethno-linguistic bases and resource and revenue-sharing issues. There has always been resistance to policy making and implementation, either by the provincial or central government. Unfortunately, energy policy issues are highly politicized in Pakistan. Prior to the 2013 general elections, Punjab's provincial government (opposition-run) had a series of sit-ins demanding a solution to the energy crisis and criticizing the central government for its energy policies. However, since the same political party, Pakistan Muslim League N (PMLN), came into power after the general elections of 2013, there has been no significant improvement in the energy situation and tall claims of overcoming the energy crisis remain unproved.

The other three provinces have their own reasons to disown the central government's plans and policies. Pakistan is blessed with a lot of hydropower potential, but due to the provincial opposition (Sindh and KPK), this huge potential remains untapped. A case in point is the issue of construction of the Kalabagh Dam on the Indus River, with a power generation capacity of approximately 3,500–4000 megawatts. According to the *Journal of Hydrology*, "Pakistan has used only about 10 percent of its estimated 40,000 mw of economically viable hydropower potential, a proportion around 30 percent lower than India and China and around 75 percent lower than other developed states."[65] Both provinces oppose construction of this hydroelectric project on the basis of possible negative effects, such as population displacement, silting up and backwater issues, the flooding of populated areas, etc. The problem is aggravated when ethno-linguistic and political spheres merge together. The International Panel of Experts (IPOE) and other feasibility studies consider these provincial apprehensions for constructing the Kalabagh Dam as baseless.[66] The devastating flood of 2010 revealed the significance of and need for building this dam; however, resentment and lack of trust and political will limits the state's ability to do so. In the case of Baluchistan Province, the case is not much different. Issues of energy resource and revenue distribution between the central and provincial governments are most acute.

Private sector participation plays an important role in national development projects. By the end of 2005, approximately 6,000 MW of electricity was being generated in Pakistan by independent power producers (IPPs). In 2006, this was followed by the induction of Rental Power Projects (RPPs), which ran into controversy and were declared illegal by the apex court. The main reasons cited were lack of transparency in awarding contracts, heavy upfront payments, and advance mobilizations. Thereafter, no worthwhile progress has been made in private sector participation.

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65 Muhammad Akhtar, Nasir Ahmed, and M. J. Booij, "The Impact of Climate Change on the Water Resources of Hindukush-Karakoram-Himalaya Region under Different Glacier Coverage Scenarios," *Journal of Hydrology* 33, no. 1 (2008): 153.

66 Muhammad Israr Khan et al., "Feasibility Study of Kalabagh Dam Pakistan," *Life Science Journal* 11, no. 9 (2014): 459.

A current spate of domestic unrest, together with provincial, localized grievances and regional security environments, have created a security dilemma, which is also a key obstruction to achieving energy security. Problems related to achieving energy security are twofold: (1) the current spate of domestic terrorism and (2) localized grievances, including sub-nationalist separatists' insurgencies. Pakistan is blessed in abundance with natural energy resources, but unfortunately their availability is mostly bounded by areas with a troubled past and present, or in areas with no infrastructure to support the extrication of energy resources. Major sources of energy like oil, gas, and coal deposits are found in provinces that have peculiar problems. For example, Khyber Pakhtunkhaw (KPK) has huge deposits of oil, but the situation with Federally Administered Tribal Areas (FATA) along the Pak-Afghan border is well documented and needs no elaboration. The discovery of Thar coal deposits, the safest and one of the cheapest forms of energy, is yet to be explored due to lack of infrastructure and sustainable, long-term, investor-friendly policies. Pakistan will have to open up to the world instead of merely relying on China for its energy sector development.[67]

Similarly, Baluchistan Province is blessed with huge gas reserves, but deep-rooted tribal issues, including tribal-separatist movements and the grievances of masses against the central government, disrupt the security equation. For example, Baluchistan Province is the major contributor of Pakistan's gas supply, but its share of consumption in total national production is only almost 6 percent. The same is the case with royalty share, which goes to this province. This treatment of the province is a clear violation of "Article 158 of the constitution of Pakistan: priority of requirements of natural gas."[68] This is not the end of the story. The situation is further complicated by the frequent disruption of gas supplies due to anti-state elements blowing up gas pipelines. Similarly, the kidnapping of foreigner engineers working in the energy sector, particularly in Gwadar, and gun

[67] Sumita Kumar, "The China-Pakistan Strategic Relationship: Trade, Investment, Energy, and Infrastructure," *Strategic Analysis* 31, no. 5 (2007): 775.

[68] Article 158: "The Province in which a well-head of natural gas is situated shall have precedence over other parts of Pakistan in meeting the requirements from the well-head, subject to the commitments and obligations as on the commencing day." It simply means that the discovery of any natural resources must first benefit the province where the discovery has been made. Sadly, the inverse is true in the case of Baluchistan and its Sui gas field.

running and bomb blasts hinder progress in developing the energy sector. This unrest is also a major deterrent for foreign investors.[69]

On the regional front, in an effort to benefit from the transnational oil and gas projects, the current regional security environment is a key impediment. Pak-Afghan, Pakistan-India, and U.S.-Iran relations, and the interests of other regional players like Russia, China, and Saudi Arabia are also key factors in harnessing these energy potentials; and for Pakistan, to assume the role of regional energy hub together with the development of Gwadar deep sea port in collaboration with China, still seems to be a daunting task.[70] Recent investment of $46 billion by the Chinese government is an important development in this regard.

[69] Sumita, "The China-Pakistan Strategic Relationship," 780.

[70] Andrew Small, *The China-Pakistan Axis: Asia's New Geopolitics* (New York: Oxford University Press, 2015), 29; Winberg Chai, "The China-Pakistan Axis: Asia's New Geopolitics," *Asian Affairs: An American Review* 42, no. 3 (2015): 170.

IV. TRANSNATIONAL PIPELINES/REGIONAL PROSPECTS: CHALLENGES AND OPPORTUNITIES

Pakistan desperately needs to achieve energy security, and time and resources are fundamental requirements to overcoming the ever-increasing gap between supply and demand. Unfortunately, Pakistan does not have the time or resources. According to 2007 EIA estimates, Pakistan's indigenous gas reserves are 28,000 bcf, which could suffice for the next twenty years.[71] However, due to an overreliance on gas and a lack of desired energy mix, energy experts fear that existing gas reserves may not last even that long and may diminish as early as 2020.[72] An enormously increasing demand for energy calls for an intelligible national energy policy that encompasses managerial issues, fact-based planning, tapping hydro-potential, mainstreaming domestic energy resources, and most important, incorporating transnational gas pipeline projects. Elizabeth Mills writes: "Pakistan is situated at the confluence of Central Asia, West Asia, and South Asia; a sure gateway for mutual regional cooperation in energy sector."[73] Therefore, Pakistan's neighboring energy-rich regional countries can not only assist Pakistan in mitigating its energy shortfalls, but can also profit from its geostrategic location. Available regional energy options include Iran-Pakistan-India (IPI), Turkmenistan-Afghanistan-Pakistan-India (TAPI), the Pakistan-Qatar gas pipeline, and an ongoing project of LNG imports from Qatar.

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[71] Annual Energy Outlook, "Energy Information Administration," *Department of Energy 92010:* 9.

[72] Energy Expert Group, *Integrated Energy Plan:2009*–2022, (Islamabad, Pakistan: Ministry of Finance, Government of Pakistan, March 2009), http://www.pc.gov.pk/hot%20links/integrated_energy_plan2009-22.pdf.

[73] Mills, "Pakistan's Energy Crisis," 27.

Figure 11. Transnational Gas Pipelines

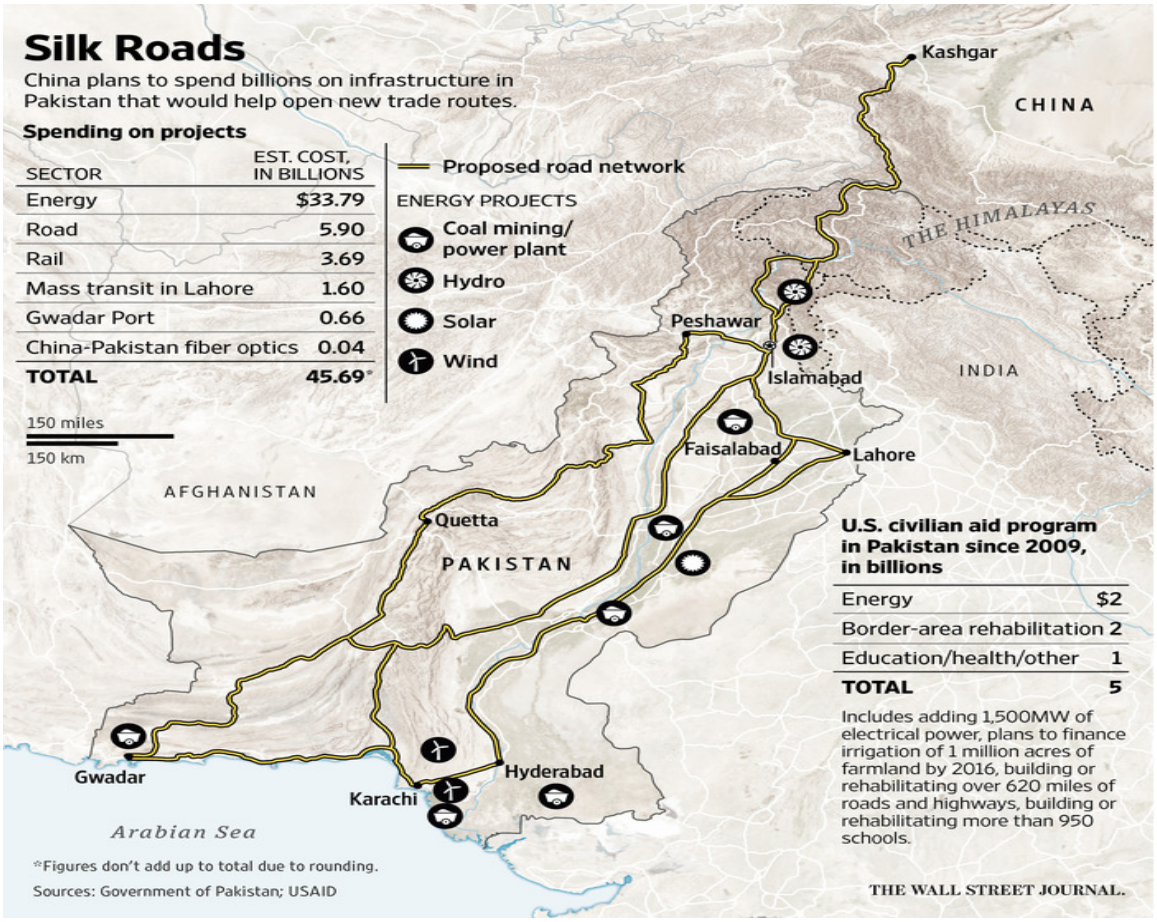
Source: Nazir Hussain, "Diplomacy and International Dimension of Energy Management," in *Solutions for Energy Crisis in Pakistan*, ed. Mushir Anwar (Islamabad, Pakistan: Islamabad Policy Research Institute, 2013), 138.

Similarly, the recent Chinese investment of $45.6 billion in the China-Pakistan Economic Corridor (CPEC) for infrastructure especially the trade routes, commonly referred as 'Silk Roads,' and energy projects is another significant development. Through this project, China will have an alternative route to bridge the Gulf energy, and Pakistan will yield significant economic benefits. Dr. Dhrubajyoti Bhattaacharjee, a research fellow at the Indian Council of World Affairs, writes: "The proposed economic corridor will connect the north-western Chinese province of Xinjiang with the Pakistani port of Gwadar through a network of roads measuring around 3,000 kilometers (1,800 miles), providing Pakistan its much needed economic infrastructure, especially power-generation plants."[74] The CPEC project will not only pacify Pakistan's energy crisis, but will generate a lot of other economic activities and create job opportunities in the much-neglected, poverty-ridden, and troubled Baluchistan Province. These economic activities

[74] Dhurbajyoti Bhattarcharjee, "China Pakistan Economic Corridor," *Indian Council of World Affairs*, May 2015: 1, http://ssrn.com/abstract=2608927.

are likely to emerge as a major stabilizing factor and will harness the internal dissent in the province.

Figure 12. Silk Roads



Source: *BBC News*, "Is China-Pakistan 'silk road' a game-changer?" April 22, 2015. http://www.bbc.com/news/world-asia-32400091

A. THE PIPELINE PROJECTS

Since the last two decades or so, Asia's share in the world economy is constantly stepping up, and consequently, its appetite for energy resources is also increasing significantly. For India, China, and even most of the globe, the access to energy fields extending from the Pacific Ocean to Iran is through pipeline projects that pass through Pakistan. Pepe Escobar notes: "Pakistan is an energy-poor, desperate customer of the grid. Becoming an energy transit country is Pakistan's once-in-a-lifetime chance to

transition from a near-failed state into an 'energy corridor' to Asia and, why not, global markets."[75] In Central Asia, Turkmenistan is ranked the number four gas producer after Russia, Iran, and Qatar. Central Asia is the world's obvious focus because it sits on the earth's biggest untapped reserves of oil and gas.

1. Iran-Pakistan-India Gas Pipeline

"The history of the IPI pipeline project can be traced back to 1988, when natural gas reserves were discovered at Pars Fields in Southern Iran."[76] However, in 2008, a tri-country consensus was built to strike the final deal.[77] In March 2010, a final agreement between Pakistan and Iran was inked at Ankara. India withdrew from the project, possibly due to strained U.S.-Iran relations and India's apprehension about Pakistan being historic rivals. According to the outlined agreement, "IPI was to initially have a capacity to deliver roughly 22 billion cubic meters per year which was to evolve to a maximum of 55 billion cubic meters. Iran would initially transfer 30 mcm (750mcf) of gas per day to Pakistan but would increase to 60mcm per day."[78] However, due to the enormous twenty-two-year delay from conception to finalization of the project, the project's cost had almost doubled—from $4 billion to $7.6 billion in 2010.[79] As of today, its cost stands much higher. The operation of the pipeline will add 4,000 megawatts of cheaper electricity to the national grid and also reinstate approximately 2,200 megawatts of currently idle thermal power. Farooq Tirmizi writes, "Pakistan would pay US$3 billion a year to Iran, but it would reduce its oil imports by US$5.3 billion, resulting in a net

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[75] Seher Abbas, "IP and TAPI in the 'New Great Game': Can Pakistan Keep Its Hopes High?" *Spotlight on Regional Affairs* 31, no. 4 (April 2012): 3.

[76] The South Pars/North Dome field is a natural gas condensate field located in the Persian Gulf. It is the world's largest gas field, shared between Iran and Qatar. According to the International Energy Agency, the field holds an estimated 50.97 trillion cubic meters (1800 trillion cubic feet) of in situ gas and some 50 billion barrels of condensates. This gas field covers an area of 9700 square km, of which 3700 square km (South Pars) is in Iranian territorial waters and 6000 square km (North Dome) is in Qatari territorial waters. See Daniel Canty, "Field Focus: Iran's South Pars Development," *Arabian Oil and Gas*, May 29, 2011, http://www.arabianoilandgas.com

[77] IPI was proposed to start from Asaluyeh, South Pars, stretching over 1,100 km in Iran itself before entering Pakistan and travelling through Khuzdar, with one section of it going to Karachi on the coast of the Arabian Sea, and the main section travelling to Multan. From Multan, the pipeline was to travel to Delhi, where it would end.

[78] Vaqar, "Solutions for Energy Crisis in Pakistan," 41.

[79] Noor-ul-Haq, "Iran-Pakistan Peace Pipeline," *IPRI Factfile,* July 2010.

reduction in oil imports by around US$2.3 billion."[80] Moreover, if the project assumes multilateral status, then foreign exchange earnings, through royalties, will further reduce the country's oil import bill.

At present, India is excluded from the pipeline project, yet the project remains open to any third party participation at the later stage. It was proposed that, with India's involvement in the project, the pipeline could be further extended up to China through Bangladesh. Any multilateral pipeline agreement will be a key to regional integration and a win-win situation politically, economically, demographically, and most importantly, from a regional security point of view. With recent improvements in U.S.-Iran relations, due to a possible U.S.-Iran nuclear deal, India's return to the IPI project is a most likely proposition because of its growing energy needs. It is evident from the fact that "India is the world's fifth-largest energy consumer; India is projected to rise to third-largest by 2030, surpassing Japan and Russia."[81] According to an EIA case scenario, India's principal energy demand is projected to swing to 1,299 MTOE in 2030, with an average annual growth rate of 3.6 percent per year.[82] India's current and projected needs provide reasonable grounds to become part of this project as soon as sanctions from Iran are lifted as a result of its possible nuclear deal with United States.

2. Turkmenistan-Afghanistan-Pakistan-India Gas Pipeline

Commonly known as TAPI, this gas pipeline project was conceived in the mid-1990s by the Union Oil Company of California (UNCOL). At the same time, Bridas Corporation, an Argentinean oil and gas giant, was working in parallel, on the same project.[83] From 1995 to 1997, Bridas officials were in consultation were Turkmenistan,

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[80] Farooq Tirmizi, "Analysis: Iran-Pakistan Pipeline a Mutually Convenient Political Stunt," *Express Tribune,* March 13, 2013.

[81] Carin Zissis, "India's Energy Crunch," *Council on Foreign Relations,* October 2007, http://www.cfr.org/publication/12200/indias energy_crunch.html.

[82] International Energy Agency. "World Energy Outlook 2007: China and India Insights." (Paris: IEA, 2007), 465. http://www.worldenergyoutlook.org/media/weowebsite/2008-1994/weo_2007.pdf

[83] Unocal Corporation explores, develops, and produces natural gas, crude oil, condensate, and natural gas liquids, with principal operations in North America and Asia. The company operates in three segments: Exploration and Production, Midstream and Marketing, and Geothermal. Bridas Corporation, founded in 1948, is an independent oil and gas holding company based in Argentina. Since March 2010 it is 50 percent owned by China National Offshore Oil Corporation.

Pakistan, and Afghanistan governments to convince these countries to join this trans-Asia gas pipeline project. However, the project ran into difficulties due to the emerging security scenario in the region. Lutz Kleveman writes: "The commercial competition between the UNOCAL and BRIDAS resulted into an open conflict between the two and ultimately ending the project as a result of the rise of Taliban and subsequently the 9/11 episode and war on terror."[84] After the tragic incident of 9/11, both companies were less interested due to the region's turmoil and unpredictable future.

Despite all odds, in 2002, Pakistan, Afghanistan, and Turkmenistan reached an agreement, signed at Ashgabad. Later, in 2006, equally energy-starved India also decided to formally join the project, primarily because the United States consented to its implementation. It is noteworthy that after signing TAPI, the Indian plea of abandoning the IPI gas pipeline project because of Pakistan's domestic security situation and traditional rivalry with India does not hold water. The impact of the United States not joining IPI stands confirmed. After having built the consensus of all stakeholders, the Asian Development Bank (ADB) provided $100 million to conduct a feasibility study of this Trans-Asia gas pipeline project.[85] Despite the willingness of all stakeholders to go ahead with the TAPI gas pipeline project and the United States' consensus in the project's favor, the construction of this megaproject could not commence due to a stalemate over Turkmenistan's proposed financial terms and conditions.

In October 2014, a significant development occurred when "Russian natural gas giant Gazprom announced that it would cease purchasing natural gas from

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[84] Lutz Klevemean, *The Great Game: Blood and Oil in Central Asia* (New York: Grove Press, 2003), 59; Ahmed Rashid, *Taliban: Militant Islam, Oil and Fundamentalism in Central Asia* (New Haven, CT: Yale University Press, 2010). Ahmed Rashid was a correspondent for the *Far Eastern Economic Review* for more than twenty years, covering Pakistan, Afghanistan, and Central Asia. He now writes for BBC Online, the *Washington Post, El Mundo,* the *International Herald Tribune*, the *New York Review of Books*, and other foreign and Pakistani newspapers. He has been covering the wars in Afghanistan, as well as the wars in Pakistan and Tajikistan, since 1979. He is the author of *Descent into Chaos* and *Jihad.*

[85] John Foster, "Afghanistan, the TAPI Pipeline, and Energy Geopolitics," *Journal of Energy Security,* March 2010; Tridivesh Singh Maini and Manish Vaid, "Roadblocks Remain to TAPI Pipeline Construction," *Oil and Gas Journal* 111, no. 3 (2013): 18. The TAPI is a 1,680 km pipeline emanating from Turkmenistan's Dulatabad (4th largest in the world with 16 trillion cubic meters) gas field, would cover 145 km in Turkmenistan, 735 km in Afghanistan, 800 km in Pakistan and enter into India. The projected US$7.6 billion pipeline would run through Dulatabad, Herat, Kandhar, Quetta, Multan to Fazilka and would supply 90 MMCMD, out of which 38 MMCMD each would be utilized by Pakistan and India and remaining 14 MMCMD by Afghanistan.

Turkmenistan."[86] In January 2015, as a follow up to its declaration, Gazprom significantly dropped the import of gas from Turkmenistan—by about two thirds. Taking advantage of Russia's significant reduction of gas imports, China promptly exploited the opportunity and inked an agreement with Turkmenistan for constructing two additional pipelines (lines C and D), increasing the gas imports from Turkmenistan from the current 35 to 65 billion cubic meter (bcm).[87]

With a significant decrease in export of natural gas to Russia coupled with the threat of total cessation of Russian supplies, Turkmenistan has been forced to depend on China for its energy exports and revenue earnings. Realizing the danger of its sole economic dependence on China, Turkmenistan decided to diversify its export markets. Besides other options, TAPI seemed to be most feasible pipeline project. Therefore, Turkmenistan now seems willing to grant vital concessions, contrary to original financing terms, to kick-start the TAPI gas pipeline project. Despite reaching a consensus, the consortium leader's selection is still pending. Big giants in the oil and gas sectors are reluctant to take the lead role in the TAPI project because Turkmenistan's law prohibits private land ownership.[88]

For Pakistan, implementation of the TAPI gas pipeline project will be a big breakthrough toward its economic sustenance. This project will generate approximately 6,000 megawatts of gridded electricity.[89] Besides easing out the energy crunch, this project will also create employment opportunities and Pakistan will earn millions of dollars on account of transit fees. The only opposition to this project comes from Russia, which despite significantly reducing its gas imports from Turkmenistan, still desires to route the pipelines to European markets through its own territory.[90] Russian interests are

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[86] Micha'el Tanchum, "A Breakthrough on the TAPI Pipeline?" *Crossroads Asia*, March 2015.

[87] Alexander Gupta, "China Doubles Down in Central Asia with New Natural Gas Pipeline," *American Security Project*, June 19, 2014.

[88] Ibid.

[89] Maini and Vaid, "Roadblocks Remain to TAPI Pipeline Construction," 21.

[90] Nikita Mendkovich, "The TAPI pipeline and Russia's Gas Policy," *New Eastern Outlook*, November 2010.

two-fold: economically benefitting from the transit revenues and keeping tabs on Central Asia's rich energy basket, thereby maintain its influence in the region.

3. Pakistan-Qatar Gas Pipeline

Like most other pipeline projects, the Pak-Qatar gas pipeline project was also conceptualized in the 1990s and still lies short of implementation. The Sharjah-based Crescent Petroleum Company proposed this project, also known as the Gulf-South Asia (GUSA) gas pipeline project. The same international company was also willing to finance the project. A survey of the proposed route was also carried out by Crescent Petroleum, incurring a cost of US$4 million, after the signing of MOU between Pakistan and Qatar in July 2000.[91]

The proposed project, still under consideration, is not cost-efficient because of high tariffs, the double cost of underwater route construction as compared to any land route, and costly maintenance. In 2012, Pakistan and Qatar inked a MOU for importing liquefied natural gas (LNG) to Pakistan. It is aimed at producing 2,500 megawatts of electricity, with a daily average import of 500 mcf. The current government is desperately perusing the LNG import project. On March 26, 2015, the first consignment ship carrying LNG anchored at the Karachi shore. After a lapse of six months, confusion still persists over the price issue—terms and conditions of contract have yet not been made public by the government. However, energy experts believe that despite the Qatari government's willingness to trade at a reduced price of US$13–14 million British thermal unit (MBTU) instead of their initial demand of US$18 MBTU, the net cost of electricity generation will be more than what Pakistan is producing from diesel.[92] The terms and conditions of the deal are not considered worthwhile, like keeping the current price frozen at the same rate for the next twenty years, whereas, a sharp decline in prices is being perceived in the next few years. Therefor the project runs contrary to the national interests, and seems to be only serving the bureaucratic interstes.[93] The Pakistani

[91] Noor-ul-Haq, "Gas Pipeline Projects in South Asia," *IPRIFactfile*, August 2005.

[92] Arshad H. Abbasi, "The LNG Deal and the Masters of Spin," *News International*, September 17, 2015, http://www.thenews.com.pk/Todays-News-9-340744-The-LNG-deal-and-the-masters-of-spin.

[93] "Pak-Qatar LNG Deal," *Dawn News*, August 18, 2015. www.dawnnews.com

government's effort to calm the severe energy crunch by importing Qatari LNG seems seriously flawed. It will raise electricity tariffs, compound the already crippling life of the common man, and cause industrial disorder and price hikes instead of providing much-desired relief. This deal is testimony of the government's institutional, political, and policy inefficiency.

Materialization of IPI and TAPI gas pipeline projects will add approximately 10,000 MW of electricity to the national grid. These pipeline projects will substantially ease Pakistan's energy shortfall burden and simultaneously strengthen its economy, by virtue of its energy corridor status. The pipelines' importance is an undeniable factor, yet these projects alone will not help achieve the desired energy security. Therefore, eyeing the much desired diversified energy mix will remain a definite need.

B. CHINA-PAKISTAN ECONOMIC CORRIDOR (CPEC)

Envisioning the proposed CPEC, it may be appropriate to consider this economic corridor as an energy corridor. Out of a $46 billion commitment for this economic corridor, which equals almost 20 percent of Pakistan's GDP, $34 billion will be utilized to generate approximately 17,000 megawatts of electricity. The remaining amount will be spent on upgrading infrastructure and supporting development.[94] The amount of electricity generated through CPEC is almost double the amount of electricity that will be produced from both the IPI and TAPI gas pipeline projects, if they materialize. It is expected that by 2017, about 10,000 megawatts of energy will enter the current national grid. This energy contribution will be a vast mix of hydro, coal, solar, and wind energy.[95] The first phase of the project is already underway, and the 100-megawatt Quaid-e-Azam

[94] Francois Godement, "Explaining China's Foreign Policy Reset," *China Analysis*, April 2015, http://www.ecfr.eu/page/-/ChinaAnalysisEng_Special_issue_1503_Final_v3_(2).pdf.

[95] Dhrubajyoti, "China Pakistan Economic Corridor," 13.

Solar Park has already been inaugurated in Bahawalpur city of Punjab Province, which will be further extended to a 1,000-megawatt power plant.[96]

Currently, Pakistan is engulfed with militancy issues, corruption scandals of high-profile influential politicians, and most importantly, the situation in Baluchistan Province, which is pivotal for implementation of CPEC. Despite these odds, China's huge investments speak of envisaged benefits as well as its transformed diplomatic objectives. In November 2014, the Chinese president spoke of "prioritizing the promotion of neighborhood diplomacy over the management of relations with other major powers."[97] However, China needs to have friendly periphery if it needs to secure its energy needs. For Pakistan, the project has an enormous potential to support its dooming economy, especially a fast-track solution to its rampant energy crisis.

With the possibility of easing out of sanctions against Iran, Beijing is also looking to benefit from the IPI pipeline project. As a part of CPEC, Beijing has already inked an agreement with Pakistan to link the Gwadar port with the existing domestic network of gas pipelines. Initially, this section of gas pipeline was to be built by Pakistan as part of the IPI project. This $2 billion pipeline construction project, including an LNG terminal construction at Gwadar, will be undertaken by the China National Petroleum Corporation (CNPC).[98] It has significantly eased Pakistan's pipeline financing issue, and now Pakistan will only have to construct the remaining 100 kilometers of pipeline from Gwadar to the Iranian border. Iran has already completed construction of its portion of pipeline. Not only Pakistan and China will benefit from an Iran-Pakistan gas pipeline, but

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[96] The US$28 billion financing agreements (first phase) include the following: 1000MW solar power park in Punjab; 870MW Suki Kanari (Khyber Pakhtunkhwa) hydropower project; 720MW Karot (AJK) hydropower project; three wind power projects at Thatta of United Energy Pakistan (100MW), Sachal (50MW) and Hydro China (50MW); Chinese government's concessional loans for the second phase upgradation of Karakorum Highway (Havelian to Thakot); Karachi-Lahore Motorway (Multan to Sukkur), Gwadar Port east-bay expressway project and Gwadar international airport; provision of material for tackling climate change; projects in the Gwadar Port region and establishment of China-Pakistan Joint Cotton Biotech Laboratory and China-Pakistan Joint Marine Research Centre.

[97] Dhrubajyoti, "China Pakistan Economic Corridor," 14.

[98] "Iran Backs Pipeline to China Under 'One Belt, One Road,' Initiative," *Press TV*, April 25, 2015, http://www.presstv.ir/Detail/2015/04/25/408042/Iran-China-gas-pipeline-sanctions-tradenuclear-zarif-kerry-obama-rouhani-Pakistan; Irfan Haider, "Details of Agreements Signed during Xi's Visit to Pakistan," Dawn, April 20, 2015, http://www.dawn.com/news/1177129/.

it will significantly impact the regional geopolitical calculus.[99] Pakistan's stance of not sending troops to Saudi Arabia and remaining neutral in the case of Saudi-Iranian conflict over Yemen is testimony to this impact. India's re-entry into the project, after the sanctions over Iran are lifted, will be another significant milestone.

The economic interdependence of Central and South Asian regions in general and South Asian countries in particular is in the making. In this scenario, the geostrategic location of Pakistan—at the confluence of South, West, and Central Asia—assumes greater significance. In its quest for energy and oil resources, this region is new Great Games' center stage and Pakistan is the gateway to Central Asia. Stephen Cohn explains Pakistan's significance: "While history has been unkind with Pakistan, its geography has been its greatest benefit."[100] Besides Russia, the two most populous and energy-desperate states, India and China, border Pakistan.

By 2050, it is believed that natural gas consumption will surpass oil consumption as a main source of energy.[101] Therefore, these transnational gas pipeline projects draw more attention, and achieving energy security through gas pipeline projects may become pivotal to national security for the countries involved. In this scenario, the significance of Pakistan as a transit economy is unmatched in the region. These projects, besides resolving age-long regional disputes among the stakeholders, "may also provide a peaceful atmosphere as well as bring an end to the arms race and ultimately help the countries in developing their health and education sector, eradicating poverty and unemployment."[102]

Undoubtedly, the regional security climate and trust deficiency remains a key hurdle to endorsing long sustainable partnerships in regional transnational gas pipeline

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[99] Micha'el Tanchum, A Post-Sanctions Iran and the Eurasian Energy Architecture: Challenges and Opportunities for the Euro-Atlantic Community, Washington, DC: Atlantic Council, September 2015.

[100] "Geo-Strategic Significance of Pakistan," http://defence.pk/threads/geo-strategic-significance-of-pakistan.269246/#ixzz3n8udQABJ.

[101] David G. Victor and Amy M. Jaffe, *Natural Gas Geopolitics: From 1970 to 2040* (New York: Cambridge University Press, 2008), 1.

[102] Anjali Sahay and Jalil Roshandel, "The Iran-Pakistan-India Natural Gas Pipeline: Implications and Challenges for Regional Security," *Strategic Analysis* 34, no. 1 (2010): 77.

projects. May it be India, Pakistan, Iran, or Afghanistan, there has to be an end to the blame game and proxy war on behalf of the larger national and regional interests. There is a greater role to be played by the regional and extra-regional players in order to achieve regional security that will ultimately lead to achieving desperately needed energy security. In this regard, Zahid Anwar writes: "The prime objective of Pakistan's foreign policy should be to develop beneficial and strong ties with all major powers and maintain cordial relations with its neighbors."[103]

Despite the regional countries' desire and consensus, rivalries between the great powers in pursuing their regional interests, remains a difficult puzzle to solve. This geopolitical game of extra-regional players revolves around the United States, Russia, and China. These players aim at establishing their hegemony over the economy and energy resources of Central Asia and extending their sphere of influence in South Asia. Mankoff writes, "This power contest in the region is neglecting the security threats these weak, fragile states are facing which is victimizing the stability of the region."[104] For implementation of the perceived gas pipeline projects, regional stability is vital, which is only possible by giving it access to the world economy. Anjali and Jalil put it this way: "It must be remembered that 'trade brings peace' and this can act as precursor to 'peace brings trade.'"[105] These transnational pipeline projects can be realized if the extra-regional influential powers like the United States, Russia, and China support them.

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[103] Zahid Anwar, "Gwadar Deep Sea Port's Emergence as Regional Trade and Transportation Hub: Prospects and Problems," *Journal of Political Studies* 1, no. 2 (2011): 102.

[104] Jeffrey Mankoff, "The United States and Central Asia After 2014," *Center for Strategic and International Studies*, January 2013, http://csis.org/files/publication/130122_Mankoff_USCentralAsia_Web.pdf.

[105] Sahay and Roshandel, "The Iran-Pakistan-India Natural Gas Pipeline," 79.

V. EXPERT OPINIONS AND CONCLUSIONS

In the twenty-first century, the progressively more significant role of developing countries in global energy cannot be overemphasized. The International Energy Agency (IEA) projects that over 90 percent of increased energy demand and carbon dioxide (CO2) emissions growth between now and 2035 will be in nonmember countries of the Organization for Economic Cooperation and Development (OECD). More so, $23 trillion of investment is required in the energy supply infrastructure of these countries.[106] The trilemma of demand, supply, and investment in developing countries hinges upon various factors, including urbanization, population growth, an upcoming middle class, energy governance, investment policy incentives, and effects of energy subsidies. These energy-starving countries, including Pakistan, still have a huge population with limited or no access to electricity: "By some estimates, as many as two billion other people in the developing world have very limited access to electricity, perhaps one appliance and several light bulbs."[107] This energy shortage extremely damages the quality of life. Per capita electricity utilization has a direct bearing on the number of human development activities: life expectancy, child development, educational standards, and access to clean drinking water. This phenomenon is explained in United Nations Development Program (UNDP) data in Figure 13.[108]

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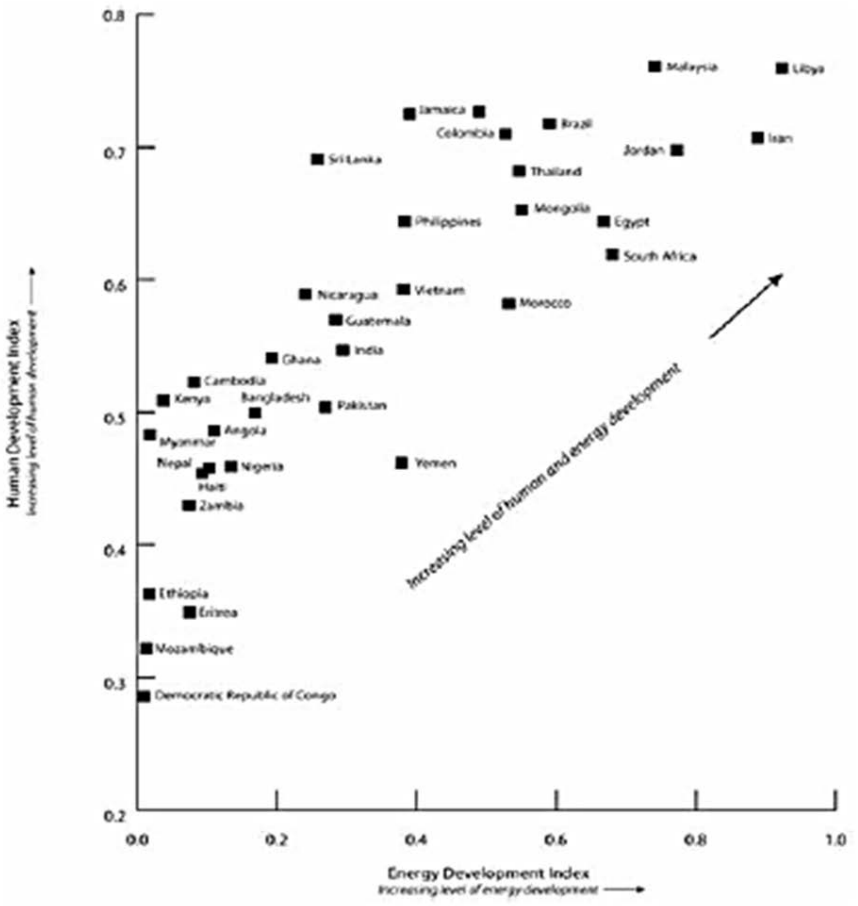
106 Jan H. Kalicki and David L. Goldwyn, eds., *Energy and Security: Strategies for a World in Transition*, 2nd ed. (Washington, DC: Woodrow Wilson Center Press, 2013), 327. See also IEA, World Energy Outlook, 2012. These estimates are based on the IEA's New Policies Scenario. This growth will be predominately in the power and transport sectors and will rely heavily on coal, gas, and oil. Consequently, the IEA expects global energy-related CO2 emissions to increase 23 percent by 2035, with non-OECD countries accounting for nearly all of this growth.

107 Coal Industry Advisory Board, "The Global Value of Coal," IEA (Paris, 2012).

108 The Energy Development Index measures per capita commercial energy consumption, per capita electricity consumption in the residential sector, share of modern fuels in total residential sector energy use, and share of population with access to electricity.

Figure 13. Energy Development Index

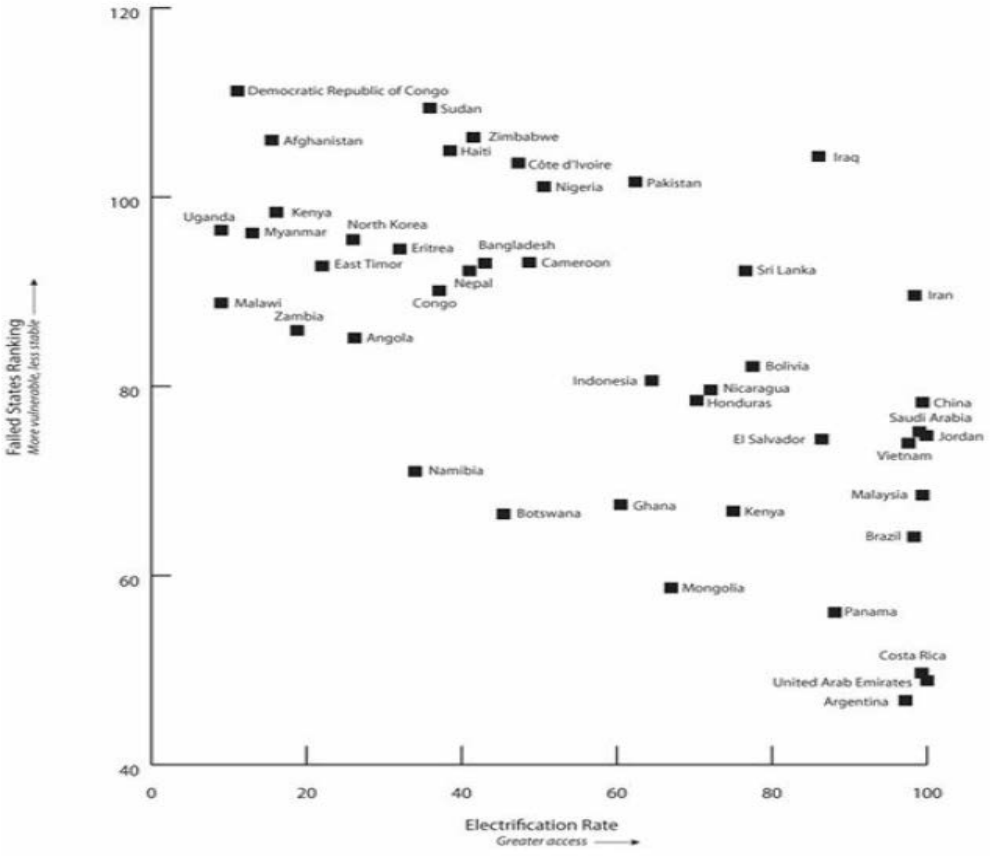


Source: For Human Development Index data, see United Nations Development Program, http://hdr.undp.org/en/statistics/. For Energy Development Index data, see http://www.worldenergyoutlook.org/resources/energydevelopment/theenergydevelopmentindex

Political stability and energy security are interdependent variables, and energy scarcity and resultant anemic economic development are detrimental to the country's

national security and regional stability as well. Figure 14 explains the relationship between energy availability and security.[109]

Figure 14. Relationship between Energy and Security



Source: Electrification rates as of 2009 from the IEA database in World Energy Outlook 2011 Paris: OECD/IEA, 2011). http://www.worldenergyoutlook.org /resources/energydevelopment/accesstoelectricity/. .

[109] The Failed States Index is produced annually by the Foreign Policy and the Fund for Peace. The higher the numerical ranking, the more at-risk a country is. Countries with rankings above 90 are considered at very high risk. The data reflects the following categories: demographic pressures, movement of refugees or internally displaced persons, vengeance-seeking group grievance, chronic and sustained human flight, uneven economic development, poverty, sharp or severe economic decline, legitimacy of the state, progressive deterioration of public services, violation of human rights and law, security apparatus, rise of factionalized elites, and intervention of external actors. For more information on the Failed States Index, see http://global.fundforpeace.org/.

A. ENERGY SECTOR GOVERNANCE

For Pakistan, financial problems, incompetent leadership, managerial shortfalls, frail political institutions, and unimpressive foreign policy are the major obstacles in tackling the issue. Reforms required by Pakistan are not much different from what Charles and Banks propose for all developing countries:

> A variety of institutional reforms (legal, regulatory, and governance) is critical for developing countries if they are to expand energy access. The case of India provides a telling example. Although the blackout in northern India in August 2012, which left 600 million people without power, was blamed initially on technical and operational issues, longstanding institutional obstacles (bureaucratic red tape, arcane land acquisition processes, an overly complex regulatory system, coal transportation bottlenecks, corruption in coal leasing, inadequate upstream coal pricing, and heavily regulated retail electricity rates) played a much larger role. Expanding grid access in emerging market countries requires a policy framework that is conducive to private sector participation and that includes the implementation of an effective, independent regulatory regime; cost recovery in the tariff system; transparent subsidy regimes; and mechanisms for funding noncommercial grid expansion into lower income rural areas. The development of smaller-scale mini grids or micro grids in rural areas using distributed generation represents a major opportunity for areas where expansion of the national grid is prohibitively expensive and commercially unviable.[110]

As U.S. secretary of state, Hillary Clinton highlighted good governance as a cornerstone of addressing energy poverty. A broad array of institutional, regulatory, and governance preconditions must be in place to support the expansion of electricity access.[111] With the United States in the lead role, other developed countries should increase their support to implement reforms in the energy sector. Good governance will help build the trust of investors and encourage donors to respond to the call for investing in the energy sector. Charles K. Ebinger further elaborates: "The leadership in emerging market countries must be committed to ending corruption and to making serious

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[110] Charles K. Ebinger and John P. Banks, "Electricity Access in Emerging Markets," in *Energy and Security: Strategies for a World in Transition*, ed. Jan H. Kalicki and David L. Goldwyn (Washington DC: Woodrow Wilson Center Press, 2013), 337.

[111] Hillary Rodham Clinton, "Energy Diplomacy in the Twenty-First Century," speech given at Georgetown University, Washington, DC, October 18, 2012.

institutional and regulatory changes. The commitment must include phasing out subsidies to encourage energy efficiency and, above all, strengthening the rule of law, which is so vital to attracting private sector investments."[112] This commitment is, of course, a daunting task and, without objectively taking the pathway of good governance, any worthwhile objectives cannot be achieved.

For Pakistan, institutional reforms can lay the foundation toward achieving energy self-sufficiency. Once put into effect, these reforms will guarantee efficient management of existing energy resources as well as judicious incorporation of renewable energy technologies.

A viable institutional framework can only be put together when policymakers play their role in developing a consensus in greater national interest above and beyond their party and own self-interests. Similarly, the reorganization of the decision-making hierarchy in the energy sector is also a fundamentally needed reform. This issue of non-centralized decision-making is not only specific to Pakistan and other developing countries, but it can also be traced equally in the developed economies of the world. Jan H. Kalicki and David L. Goldwyn write the following about the United States:

> Energy-related decision-making is, unfortunately, largely dysfunctional at the national and global levels. As with other issues, U.S. energy decision-making has been built incrementally over time, with different responsibilities assigned to at least 10 different departments and agencies in the executive branch and with more than 30 congressional committees and subcommittees that more often reinforce shared turf with executive agencies than promote a unified strategic view.[113]

However, the United States is not confronted with issues that are at the core of developing countries. Besides other institutional reforms needed for a workable national energy policy, there should be a unified decision-making apex body representing all energy-related institutions. Frank Verrastro and Kevin Book write:

> In an ideal world, the formulation of a comprehensive and balanced national energy policy would begin with timely and accurate data,

[112] Ebinger and Banks, "Electricity Access in Emerging Markets," 340.

[113] Kalicki and Goldwyn, eds., *Energy and Security*, 423.

> incorporate solid analysis, and then balance the tradeoffs required between competing or conflicting economic, security, and environmental objectives. Policymakers would share unbiased information to arrive at long-term strategic decisions to keep the nation on track. Flexible and adaptive rules and regulations would accommodate technology advances, foreign policy priorities, changing market conditions, and public sensitivities and perceptions.[114]

Unfortunately, the present policy apparatus is exceedingly disjointed and totally reactive. Its devastating effects on economy and other walks of life are evident. The crisis situation can be greatly restored if energy-related functionaries are melded together.

B. DOMESTIC ENERGY RESOURCES AND FINANCIAL ISSUES

Countries like Pakistan, blessed with huge natural resources, are unable to plug the energy demand-supply gap due to lack of financial support from the international community. USGS-supported geological surveys in the Thar Desert of Pakistan show that it has coal reserves worth US$5,540 billion.[115] The amount of energy that can be produced from this coal can meet the country's need for years to come. However, the lack of finances for infrastructure development and water scarcity in the resource-rich desert prevent execution of such megaprojects. Unless institutional reforms are not in place, multinational companies or international organizations will be hesitant to support such projects. John P. Banks writes: "Most analyses indicate that the level of financial support required to provide electricity to everyone in the developing world must increase dramatically. … It is particularly incumbent on the world's wealthiest economies to do more. … United States should lead in providing financial assistance in this endeavor."[116]

Developed economies the world over are based upon cheap energy sources, and coal is the most prominent source of energy. As of 2015, 40 percent of energy worldwide is still being produced from coal, despite environmental concerns. Dr. Shoukat Hameed Khan writes that despite the technological advances, coal will continue to remain a major

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[114] Frank Verrastro and Kevin Book, "The Challenge of Politics," in *Energy and Security*, ed. Kalicki and Goldwyn, 394.

[115] Shaikh, et al., "Energy Crisis in Pakistan," 1–10.

[116] Ebinger and Banks, "Electricity Access in Emerging Markets," 340.

source of energy.[117] However, the climatic effects due to carbon emission are not as devastating as perceived. For example, "the IEA states that achieving its 'Energy for All' scenarios would increase CO2 emission by 0.6 percent in 2030."[118] In this scenario, the major sources of energy still remain fossil fuels. If developed economies provide the financial support, assist in building the requisite infrastructure, and help in the transfer of technology for efficient combustion of coal, such as ultra-supercritical systems, Pakistan can substantially overcome its energy shortages without running counter to environmental concerns.

C. CASE FOR RENEWABLE ENERGY

In an effort to catch up with the developed world and diversify its energy mix, Pakistan needs to incorporate renewable energy projects. M. Farooq writes, "Pakistan has great potential for different kinds of renewable energies like solar thermal, biomass, wind, and hydel technologies."[119] However, despite launching the Renewable Energy Policy in 2006, no worthwhile contribution has been made in the energy sector.[120] The reasons are twofold. The high cost of developing physical infrastructure and transmission and distribution systems, and the unavailability of capital investment with common people, coupled with high interest loans, render this form of energy unfeasible. Secondly, the governance issue—such as an absolute lack of coordination at all levels between policy makers, R&D organizations, banks, importers, and users—further complicates matters. Recently, the inauguration of the Quaid-e-Azam solar park and the installation of windmills in Sind Province as part of the CPEC project are positive steps in this direction. If the mistakes of the past are repeated and a pool of experts on renewable technologies is not created, despite financing through the CPEC project, the outcome is likely to remain dismal.

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[117] Ahmed, "Solutions for Energy Crisis in Pakistan," 247.

[118] Ebinger and Banks, "Electricity Access in Emerging Markets," 341.

[119] M. Farooq and A. Shakoor, "Severe Energy Crisis and Solar Thermal Energy as a Viable Option for Pakistan," *Journal of Renewable and Sustainable Energy* 5, no.1 (2013). Dr. M. Farooq is the Directorate of Quality Enhancement at Bahauddin Zakariya University in Multan, Pakistan.

[120] Ministry of Water and Power, "Policy for Development of Renewable Energy."

D. RESEARCH AND DEVELOPMENT (R&D)

In Pakistan, lack of objective R&D is another missing link. In any long-lasting technological development, R&D plays a pivotal role. Institutional inadequacies and dependence on multinational institutions have always put indigenous R&D on the back burner. This practice in the energy sector has not only aggravated the deepening energy crisis, but it has drained the national exchequer, which is detrimental to Pakistan's national economy. There is a dire need to create a conducive environment for public-private partnerships in R&D projects. A huge amount of money is spent on energy-related R&D projects in the leading economies of the world.

E. FOREIGN POLICY, REGIONAL ENERGY PROSPECTS, AND NATIONAL SECURITY

Most developed economies, even with an abundance of domestic energy resources, have to rely on the energy resources of other nations. Their successful, mutual interdependence can be best explained by the quality of foreign policy initiatives, which ultimately ensures national as well as regional security. Foreign policy plays a significant role in reaping the benefits of regional and trans-regional energy resources. In the case of Pakistan, all transnational gas pipeline projects, already discussed at length, have not only the prospect of meeting Pakistan's energy needs, but of meeting the much-needed national and regional security and energy objectives. Foreign policy must be judiciously utilized and common grounds of mutual interest explored. Otherwise, the turf of energy may run counter to national interests.

1. Energy Security vis-à-vis National Security

Energy security has a direct bearing on national security. Daniel Yergin defines energy security as follows: "Objective of energy security is to assure adequate reliable supplies of energy at reasonable prices and in ways that do not jeopardize major national values and objectives."[121] This definition explains four different, but equally important, dimensions of the energy security: first, the adequacy of energy resources for present and

[121] John S. Duffield, *Fuels Paradise: Seeking Energy Security in Europe, Japan, and the United States* (Baltimore: John Hopkins University Press, 2015), 82.

predicted future use; second, the assurance of not being subject to disruption in terms of duration or magnitude; third, the economic viability; and fourth, the non-compromise of national objectives. Defects in any of the above dimensions result in energy insecurity, which also runs counter to national security. Any of these four dimensions can be affected by domestic as well as external threats. External threats are more relevant to the level of foreign policy initiatives. Therefore, the national energy policy must have contingencies in place to deal with defects in any of these dimensions and must possess options, such as maintaining the Strategic Petroleum Reserves (SPR).

2. Diplomacy of Pipelines

For Pakistan, its inability to benefit from proposed transnational gas pipelines can mostly be attributed to ineffective foreign policy. Almost all of the transnational pipeline projects were conceived in the 1990s, but even after a lapse of almost a quarter of a century; these projects have not materialized. Pakistan must benefit from its geostrategic pivotal location and create a conducive environment, which Frank Verrastro calls the coalitions of the concerned. The objectives of Pakistan's foreign policy should be twofold. First, it should be able to project Pakistan as a country serious about addressing its energy shortfalls. Of course, it requires contemplating and implementing reforms and good governance in the energy sector. Second, Pakistan's foreign policy should utilize diplomatic channels to pursue regional energy alignment between the consumers and producers. These transnational pipeline projects, once implemented, will be a win-win situation for all stakeholders, and this economic interdependence will result in settling age-old disputes and help stabilize the region. Once this is achieved, it will surely change the life of millions of people currently living below the poverty line.

F. UNIVERSITIES AND THINK TANKS

Universities and think tanks can play an important role in energy conservation by developing model projects on campus and through public awareness campaigns. This may subsequently lead to outreach initiatives. Boston University in Massachusetts has achieved substantial results in energy conservation through the use of "LED lighting retrofits; occupying sensors; daylight-responsive lighting controls; de-lamping; and boiler

efficiency upgrade."122 Similarly, universities should be funded to undertake student-led research on different energy pathways, and, together with think tanks, students should be provided opportunities to host workshops to foster awareness among the masses, media community, and industrial energy consumers.

G. CONCLUSION

Pakistan stands far away from developing an energy policy, which necessitates a total government approach as a precursor to achieving energy security. Without effective, implementable energy policy, Pakistan's huge domestic potential for energy production cannot be utilized optimally. Big oil and gas giants will remain reluctant to invest in Pakistan unless a conducive security and investment environment is created. Similarly, effective integration of national and foreign policy with an economic and energy policy is a must for perfect utilization of domestic energy resources, benefiting from regional energy potentials, creating economic stability, and achieving broader national security.

Some Pakistani energy experts opine that since Pakistan has enough coal reserves to meet its energy needs, it does not need to aspire to regional projects. This argument runs counter to the objectives of achieving energy and national security, energy equity, global climatic concerns, and diversification of Pakistan's energy mix.[123] Bennett Johnston writes: "In the longer term, progress toward regional infrastructure and eventually regional energy reserves can go far in helping highly diverse countries to navigate between the adversarial and the cooperative in Asia."[124] Therefore, the proposed regional gas pipeline and liquefied natural gas trade plans will cater to the ever-growing appetite of energy by the regional countries at market prices and will eventually accelerate region's economic growth. Johnston believes that the "stronger the economic and energy foundation, the greater the growth and, ultimately, the peace of this

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122 Sustainability @ BU, "Energy," http://www.bu.edu/sustainability/what-were-doing/energy/. Last accessed on November 16, 2015.

123 Robert E. Looney, *World Energy Council Trilemma Framework,* lecture notes taken at Naval Postgraduate School on Energy Security, Monterey, CA, October 14, 2015.

124 J. Bennett Johnston, "Commentary on Part IV," in *Energy and Security,* ed. Kalicki and Goldwyn, 258.

extraordinarily dynamic region will become."[125] The prime milestone of the progress of these bold initiatives will hinge upon the developed economies of the world, and the United States will have to assume leadership as mediator, stakeholder, bridge builder, and facilitator of multifaceted organizations.

[125] Ibid.

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APPENDIX A. STRUCTURE OF PAKISTAN'S POWER SECTOR[126]

Non-existence of a single decision-making body has greatly affected the policy and decision-making, encompassing all facets of the energy sector. Different regulatory authorities in the structure of Pakistan's power sector are described as follows:

- Karachi Electric Supply Corporation (KESC), serving the city of Karachi and its adjoining areas (about 13–15 percent of Pakistan's power market)
- Water and Power Development Authority's Power Wing (WAPDA), which serves the rest of the country

Both utilities have owned and operated generation facilities, as well as transmission and distribution networks. KESC still operates as a separate, vertically integrated utility, but it is now predominantly in private hands, after 73 percent of the shares were sold to private investors in November 2005. WAPDA, however, was restructured into 15 incorporated entities, all of them state-owned, as follows:

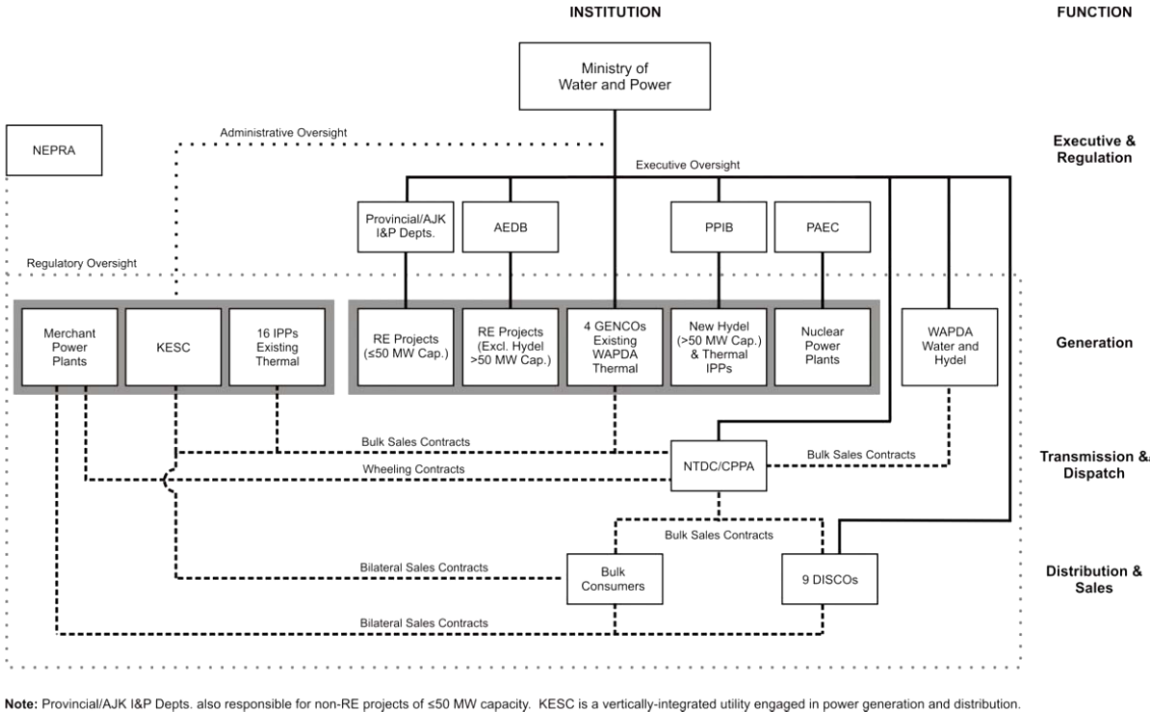
- Four thermal generation companies (GENCOs): (1) Jamshoro Power Generation Company (GENCO-1, 1024 MW installed/870 MW available), with headquarters at Jamshoro district Dadu, near Hyderabad in Sindh; (2) Central Power Generation Company (GENCO-2, 1655 MW/1400 MW), with headquarters at Guddu, district Jacobabad in Sindh; (3) Northern Power Generation Company (GENCO-3, 1856 MW/1700 MW), with headquarters at Muzaffargarh in Punjab; and (4) Lakhra Power Generation Company (GENCO-4, 150 MW/120 MW) at Khanote in Sindh
- A National Transmission and Dispatch Company (NTDC), in charge of operating the transmission system (220-kV and 500-kV network) and performing a dispatch function; its headquarters are in Lahore, while the National Dispatch Center is in Islamabad
- Nine electricity distribution companies (DISCOs), of which five are in the Punjab province (Islamabad Electricity Service Company—IESCO; Lahore Electricity Service Company—LESCO; Faisalabad Electricity Service Company—FESCO; Gujranwala Electric Power Company—GEPCO; and Multan Electric Power Company—MEPCO); one in Balochistan (Quetta Electricity Service Company—QESCO); one in Sindh (Hyderabad Electricity Service Company—HESCO); one in Northwest Frontier Province (Peshawar Electricity Service Company—ESCO); and

[126] Vladislav and Achilles, "Power Sector Reforms in Pakistan."

one in Federally Administered Tribal Areas (Tribal Electricity Service Company—TESCO)

- WAPDA continues to operate hydropower plants.

APPENDIX B. INSTITUTIONAL ORGANIZATION OF PAKISTAN'S POWER SECTOR



Note: Provincial/AJK I&P Depts. also responsible for non-RE projects of ≤50 MW capacity. KESC is a vertically-integrated utility engaged in power generation and distribution.

Source: "Policy for Development of Renewable Energy for Power Generation" (Minister for Water and Power, Government of Pakistan, 2006).

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